

amateur radio

Vol. 38, No. 4

APRIL, 1970

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amateur radio

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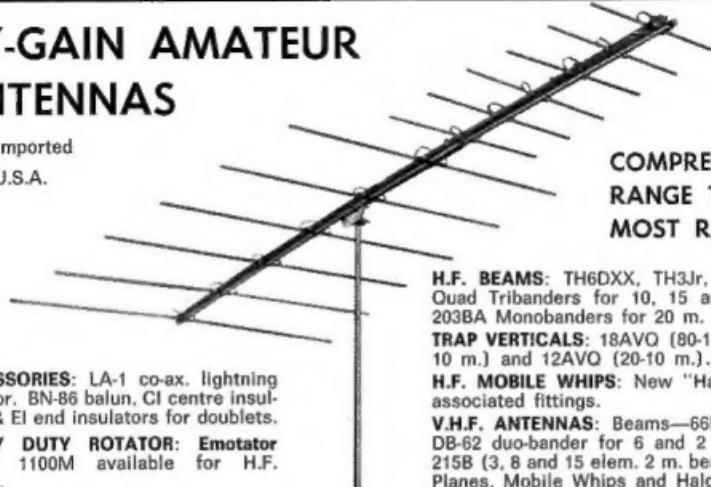
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COVER STORY

Wolf Melchhardt (left) and Rick Sayers, VK4ZRS (right) of the Townsville Amateur Radio Club. Picture shows ingenious method of mounting 3 el. beam for 2 metre tx hunt on back of VK4EX's small sedan.

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THE WHEATSTONE BRIDGE

LECTURE No. 4

The purpose of this lecture is to provide further practice with Ohms Law, and leads to the development of a practical Wheatstone Bridge suitable for measurement of Resistance, Capacitance and Inductance.

The Wheatstone Bridge is a device for accurate measurement of Resistance, Capacitance and Inductance.

The basic bridge was invented in 1833 by Samuel Hunter Christie, but no practical applications for its use were developed until 1843. In that year, Sir Charles Wheatstone applied Ohms Law to the bridge network in connection with problems in telegraphy.

As a result of this work the bridge has been known ever since as the Wheatstone Bridge.

Now-a-days there are many variations of the Wheatstone Bridge, these having been developed for specific purposes.

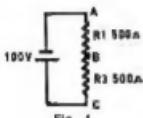


Fig. 1.

Consider the circuit of Fig. 1. Let each resistance be exactly 500 ohms and assume that the battery has no internal resistance. We know from d.c. theory that the total value of the two resistances will be 1,000 ohms.

We also know from our studies of Ohms Law that the voltage between A and B will be exactly the same as between B and C.

Let us prove this.

Firstly, we have to find the current (I) flowing in the two resistances.

From Ohms Law,

$$I = E + R$$

$$\text{therefore } I = 100 + 1,000$$

$$= 0.1 \text{ ampere or}$$

$$100 \text{ milliamperes.}$$

Next find the voltage between A and B.

Transposing Ohms Law formula,

$$E = I \times R$$

$$\text{therefore } E = 0.1 \times 500$$

$$= 50 \text{ volts.}$$

Now, since in our problem each of the two resistances is exactly equal to the other, then the voltage between B and C is also 50 volts.

The next step to develop the Wheatstone Bridge is to add two more resistances, each of exactly 500 ohms, wired in series and the combination connected in parallel across the battery (see Fig. 2).

Since R2 and R4 are exactly the same in value as R1 and R3, it follows that the current flowing in R2 and R4 is also 0.1 ampere.

* 6 Adrian Street, Collie, Vic., 3250.

Continuing the series of lectures by C. A. Cullinan, VK3AXU, at Broadcast Station 3CS for students studying for a P.M.G. Radio Operator's Certificate.

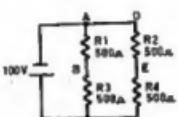


Fig. 2.

Therefore the voltage between D and E will be 50 volts, and between E and F, 50 volts.

We also know from d.c. theory that the current which flows in R1 and R3 flows in the same direction as the current in R2 and R4.

Therefore it becomes obvious that as the voltage at both B and E is 50 volts in respect to either the positive or negative pole of the battery, and as the polarity must be the same at both B and E, then there cannot be any difference of voltage, or potential difference, between B and E.

PRACTICAL EXPERIMENT

Connect a voltmeter of a type which does not consume current (such as a vacuum tube voltmeter) between points B and E. We will not be able to read any voltage.

Next let us remove the voltmeter and replace it with a sensitive ammeter.

This ammeter will have some resistance and we can now re-draw the circuit (Fig. 3) to show this ammeter.

In practice it would be a microammeter having the pointer in the centre of the scale when no current is flowing. A current of 100 microamperes in either a positive or negative direction will cause the pointer to move full scale, either right or left. Such a meter is known as zero centre meter.

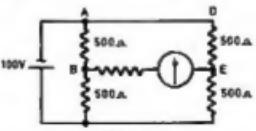


Fig. 3.

It will be found that no current will flow in the ammeter, because there is no potential difference between B and E.

What we have done so far is to prove that when R1, R2, R3 and R4 are exactly equal, no current will flow in the ammeter.

C. A. CULLINAN,* VK3AXU

Suppose now that we change the value of the resistors. Let us make R1 and R2 each exactly 750 ohms and R3 and R4 250 ohms.

Using the formulae shown previously we find that the voltage between A and B, and also between D and E, will be 75 volts each, and between B and C, and also between E and F, will be 25 volts each. Once again no potential difference will exist between B and E, therefore no current can flow in the ammeter.

If we continue this type of analysis we find that if R1 and R2 are exactly equal and, if R3 and R4 are also equal, although R1, R2, R3 and R4 can be widely different (say 999 ohms each for R1 and R2, and 1 ohm for R3 and R4), then no current will flow in the ammeter. Calculate these figures and verify this statement.

But if we change the value of any one of the resistors, then current will flow in the ammeter because a potential difference will exist between B and E. Let us go back to our circuit and change the resistor values a little as shown in Fig. 4, for example. (Note erratum in the value of R4; this should read 100 ohms.)

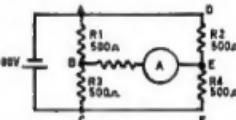


Fig. 4.

Notes.—The value of R4 as shown is incorrect. R4 should read 100 ohms.

From our previous calculations we know that the voltage at B is 50 volts in respect to either A or C. However the voltage at E will be:

Between D and E, 83.33 volts,

and between E and F, 16.66 volts.

(Because of the recurring decimals, the total calculated voltage is not 100, but this does not matter in this calculation because it is sufficiently accurate.)

We now see that a potential or voltage difference exists between points B and E. Measure this with a vacuum tube voltmeter.

Now if we connect our ammeter between B and E it will show a current flow. Because of this current flow through the ammeter, our calculations above will not be exactly correct although they are for the vacuum tube voltmeter. Again we need not worry about this discrepancy.

We have now established the following regarding the Wheatstone Bridge:

1. If resistances R1 and R2 are equal to each other, no current flows in the ammeter if resistances R3 and R4 also are equal to each other. In other words, the Bridge is in a balanced condition.

2. If resistances R1 and R2 are equal to each other, current will flow

in the ammeter if resistances R_3 and R_4 are not equal to each other. The Bridge is unbalanced.

3. If resistances R_1 and R_2 are equal to each other and if either R_3 or R_4 is adjusted so that they become equal to each other, the Bridge becomes balanced and current will cease to flow through the ammeter.

4. If resistances R_1 and R_2 are equal to each other and either R_3 or R_4 is made an accurately calibrated variable resistance, then if we connect an unknown resistance for the remaining resistor we can measure the value of the unknown resistance by adjusting the calibrated resistance until no current flows in the ammeter, indicating that the bridge is balanced. We then read the scale or calibration of the calibrated resistor to give us the value of the unknown resistance.

Therefore Bridge Balance is obtained when $R_1 + R_3 = R_2 + R_4$.

Further mathematical analysis will show, too, that Bridge Balance can be obtained when $R_1, R_4 = R_2, R_3$.

A SIMPLE PRACTICAL BRIDGE

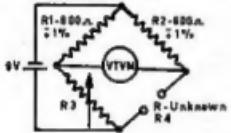


Fig. 5.

R_3 is an adjustable, calibrated resistor, known as a decade resistance box. It can be adjusted in steps of 1 ohm from 0 to 1,111,110 ohms.

It consists of six switches. Each switch has one moving pole and eleven positions (Fig. 6). Position 1 is 0 ohms.

Switch 1 has 10 resistors each 1 ohm ±1%, knob marked $\times 1$.
 Switch 2 has 10 resistors each 10 ohms ±1%, knob marked $\times 10$.
 Switch 3 has 10 resistors each 100 ohms ±1%, knob marked $\times 100$.
 Switch 4 has 10 resistors each 1,000 ohms ±1%, knob marked $\times 1K$.
 Switch 5 has 10 resistors each 10K ohms ±1%, knob marked $\times 10K$.
 Switch 6 has 10 resistors each 100K ohms ±1%, knob marked $\times 100K$.

The switches are wired in series.

The IN on the first switch and the OUT on the last switch are wired to terminals on the box so that it can be connected into various circuits.

The resistors are high stability types and the switches of good quality, preferably ceramic.

In a precision box artificially aged wire-wound resistances would be used.

PRACTICAL WORK

The following items are available:—

Two 600 ohms ±1% resistors.

One decade resistance box as described above.

One 9V. battery.

One vacuum tube voltmeter. The meter can be set to half scale electrically to give a centre zero meter and use the 1½ volts d.c. range for the bridge.

One centre zero micro-ammeter, 100-0-100 A.

Make up the above bridge using these components (Fig. 5). Use a number of different resistors as the unknown and balance the bridge with the decade resistance box. Note that sometimes an exact balance cannot be obtained because the exact value lies between two successive 1-ohm steps.

For normal practical radio work this bridge will measure resistors within its range with sufficient accuracy.

Balance occurs when $R_1 + R_3 = R_2 + R_4$, or

$$R_1, R_4 = R_2, R_3.$$

$$\text{Thus } R_4 = (R_2 \times R_3) + R_1.$$

$$\text{Therefore } R_4 = R_3 (R_2 + R_1).$$

This means that R_4 must always be equal to the value of R_3 times the multiplying factor $(R_2 + R_1)$.

If some fixed value is set for R_1 , then a change in R_2 alone will change the multiplying factor.

Now this means that we can expand the usefulness of the original bridge to cover far greater values of R_4 , and this gives us a means of measuring a wide variety of resistance values if we allow R_4 to represent each of these known resistances. Let us call R_4 , R unknown R_x or R_s . (The u or x signifying unknown.)

We can design, now, a more practical bridge than our earlier one.

Firstly, make R_1 two precision resistors; 1,000 ohms and 10,000 ohms, with a switch so that either can be used, will be very suitable. The 1,000 ohm resistor used in one position only.

Secondly, R_2 can be a number of switched precision resistors so that we can alter the ratio of R_1 to R_2 . It is desirable that the resistors for R_2 change in the ratio of 10:1 to make mental calculations easy. Thus R_2 can be resistors one each of 1 ohm, 10 ohms, 100 ohms, 1,000 ohms, 10,000 ohms and two of 100,000 ohms.

The multiplying factors we get will be:—

$$\begin{aligned} R_2 + R_1 &= 1 + 10,000 \\ &= 10 + 10,000 \\ &= 100 + 10,000 \\ &= 1,000 + 10,000 \\ &= 10,000 + 10,000 \\ &= 100,000 + 10,000 \\ \text{and } &100,000 + 1,000. \end{aligned}$$

In decimal equivalents these are: 0.0001, 0.001, 0.01, 0.1, 1.0, 10.0, and 100.0.

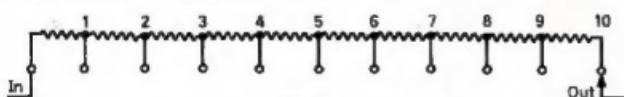


Fig. 6.

Thirdly, let R_3 be a calibrated adjustable resistance of maximum value of 10,000 ohms. It can be a calibrated rheostat or a decade resistance box.

Referring back to our previous formula, $R_x = (R_2 \times R_3) + R_1 = R_2 (R_2 + R_1)$.

Now let us assume that R_3 is set for 100 ohms and that R_2 is switched to its 1 ohm resistor, then the bridge will balance only when R_x , the unknown, is 0.01 ohm, i.e. $R_x = 100$ ohms. Ratio $(R_2 + R_1) = 0.0001 = 100 \times 0.0001 = 0.01$ ohm.

At the other end of the range of measurement of the instrument let the balance of the bridge be obtained with R_3 at maximum resistance, 10,000 ohms, R_1 switched to 1,000 ohms and R_2 switched to 100,000 ohms. The ratio of $R_2 + R_1 = 100$, so the value of the unknown resistance R_x is $R_3 \times 100 = 10,000 \times 100 = 1$ megohm.

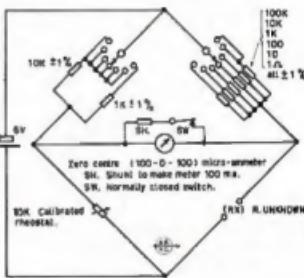


Fig. 7.

Note that only one 100,000 ohm resistor is used in R_2 by paralleling the 6th and 7th contacts of the switch.

Depending on how small R_3 can be set, in its minimum position, the range of measurement will be from 0.001 ohm (if R_3 is 10 ohms) to 1 megohm, and the accuracy will depend on the degree of precision of all the resistors in use.

In many bridges R_3 is a 10,000 ohms rheostat which has been calibrated so that 100 ohms is marked 0.1, 500 ohms 0.5, 1,000 ohms 1.0, 5,000 ohms 5, and 10,000 ohms 10, with appropriate markings in between.

In practice, a bridge of this type can be made to measure to 0.001 ohm although theoretically it could go to 0.0001 ohm.)

The switch for the multiplying or ratio resistors R_2 is marked with the multiplying factor. When balance is obtained it is only necessary to read the numerical calibration of R_3 and multiplying by the multiplier with simple mental arithmetic.

The next part of this lecture will deal with variations of the Wheatstone Bridge using a.c. as the power source and will conclude with a description of a versatile general-purpose bridge.

ALTERNATING CURRENT RESISTANCE MEASUREMENTS

The Wheatstone Bridges described so far use d.c. for the power source and a sensitive ammeter as the null or balance indicator.

However, it is possible to use an alternating current as the power source and a pair of headphones to detect the null or balance when obtaining the d.c. resistance of a resistance.

If an audio frequency oscillator, operating at 1,000 cycles per second, is connected in place of the battery as the power supply, then this tone will be heard in a pair of headphones, which are connected in place of the meter, except when the bridge is in perfect balance, and sometimes this is the preferred method to use.

However, it is essential that the a.c. resistance or reactance of the resistor being measured is very small, and not greater than the reactance of the various resistances used in the bridge. For instance, if the bridge is made from non-inductive resistors or resistors having negligible reactance at 1 KHz, then if a highly inductive resistor is used as the unknown, a proper balance would not be obtained.

However, it is possible to balance out the reactive component by connecting a condenser across one of the other arms of the bridge.

THE WHEATSTONE BRIDGE FOR MEASUREMENT OF CAPACITANCE

We have already seen that the Wheatstone Bridge can be used with a source of alternating current for the measurement of resistance, and since a capacitance will pass an alternating current, but will block a direct current, it would appear feasible to use an a.c. version of the Wheatstone Bridge to measure capacitance, and we will find that this is so although the bridge has to be arranged a little differently to the resistance bridge.

The reactance of a capacitance (condenser) is known as X_C and is derived from the formula X_C (in ohms) = $1 + 2\pi FC$, where F is any frequency in Hertz (cycles) per second, C is the capacitance in farads.

Let us find the reactance of a condenser of 0.01 μ F. at 1,000 Hz. (cycles per second).

$$X_C = 2 \times 3.14 \times 1000 \times 0.01 \times 10^{-6}$$

If the reactance of some condensers is calculated to three significant figures at the same frequency, it will be seen that the reactance of a condenser varies in inverse proportion to its capacity, i.e. at 1,000 Hz.:

0.001 μ F. =	159,100 ohms
0.01 μ F. =	15,910 "
0.1 μ F. =	1,591 "
1.0 μ F. =	159 "

Obviously from this we cannot substitute an unknown condenser in place of the unknown resistance (R_X) in our resistance bridge.

However, let us examine the situation with our simple bridge if we substitute a known value of capacitance for one of the ratio arms of the bridge (Fig. 8).

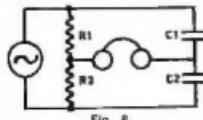


Fig. 8.

Referring to our earlier discussion of the development of the Wheatstone Bridge, we can apply the same reasoning to this new circuit.

If the resistance of R_1 equals the reactance of C_1 , and if the resistance of R_3 equals the reactance of C_2 , then the bridge will balance. (This statement is a simplification of the system.)

The formula for balance is:-

$$\frac{R_1}{C_1} = \frac{R_3}{C_2}$$

$$\text{or } \frac{R_3}{C_1} = \frac{R_1}{C_2}$$

$$\text{This becomes } C_1 = \frac{R_3}{R_1} (C_2). \quad (C_2)$$

Therefore we make C_2 a condenser of known value, of good quality and high accuracy and use it as a standard of reference.

The bridge now appears as shown in Fig. 9.

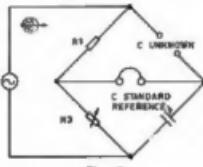


Fig. 9.

We can easily make this bridge more practical and incorporate it in some of the resistances used in our more elaborate d.c. resistance bridge.

Firstly, we change the previous bank of multiplier resistances over to the R_1 position, leave R_3 the calibrated variable resistance and use two switched standard condensers in place of the previous unknown resistance R_2 . C_1 , the unknown condenser, takes the place of R_2 .

However, we still have a problem to solve.

Condensers have internal resistance and this can vary considerably. The losses in condensers cause the power factor of condensers to differ widely and unless the power factor of the unknown condenser is equal, exactly, to that of the standard reference condenser, then the bridge will not balance because the phase shifts will not be the same.

Now precision condensers are necessarily good condensers and they are expensive, but they will have very low losses hence the power factor will be low.

If a condenser could be manufactured without losses then its power factor would be zero and if a resistance were added in series with it, then the combination would represent a condenser with losses.

Now if the standard reference condenser is a really good one, with negligible losses, then we could add a variable resistance in series with it to make its power factor the same as that of the unknown condenser (unless the unknown has an even better power factor, a rather unlikely situation if we make a good bridge).

An expression for the approximate power factor is:-

$$\text{Power factor} = \frac{1}{2 \times FC}$$

$$= R (2 \times FC)$$

where R is the value of the series resistance of the condenser, and $1 + 2\pi FC$ is the reactance of the condenser.

This is known as the Dissipation Factor, CD .

In order to cover a wide range of capacitance measurement, it is desirable to use two standard reference condensers, one of 0.01μ F. and the other 0.1μ F. Both should be high quality mica condensers, not paper dielectric types as the mica ones will have lower losses.

Each condenser should be accurate in its value to within $\pm 1\%$.

Let us see what happens if we calculate the power factor for the 0.01μ F. condenser at 1,000 Hz. from the above formula.

$$\text{Power factor (Pf)} =$$

$$6.28 \times 1,000 \times 0.01 \times 10^{-6}$$

$$= 0.0000628$$

assuming the condenser has negligible losses.

If we wish to be able to compensate for unknown condensers having a power factor up to 1.0 we must put a variable resistor in series with our 0.01μ F. condenser so that it will appear to have a power factor of 1.0.

If we calculate the maximum value of this resistor we will find that one of 16,000 ohms will give a power factor of 1.0048 i.e. $0.0000628 \times 16,000 = 1.0048$. Whilst 0 ohms will give a power factor of 0. Therefore various resistance values between 0 and 16,000 ohms will enable us to obtain power factor or dissipation factor adjustments between 0 and 1.

However in order to use the 0.1μ F. standard condenser it would not be practicable to utilise the 16,000 ohms variable resistor but one of one-tenth this resistance would be suitable.

In practice, it may not be possible to obtain variable resistances of exactly 1,600 and 16,000 ohms, so that it would be necessary to use standard rheostats or potentiometers of 2,000 and 20,000 ohms respectively and ignore the resistance above either 1,600 ohms or 16,000 ohms.

Each of these two resistances can be calibrated 0-10 and given simple multiplying factors to make the bridge more readily useable.

In bridge terminology the 16,000 ohms variable resistor is known as a DQ resistor and the 1,600 ohms variable resistor is labelled CD. The switch used to change from one to the other is labelled CDQ.

The practical bridge now appears as shown in Fig. 10.

To operate the bridge, S_1 is set to the approximate range for the condenser to be measured. R_2 is then varied for minimum sound in the headphones. S_2 is switched to CD and the CD resistance varied, together with R_3 . If a proper null cannot be found, S_2 is switched to DQ and the DQ resistor

varied, together with R3. There may be some interlocking between R3 and either the CD or DQ resistors. Also, it may be necessary to alter the setting of switch S1. It may not be possible to get a complete null but the one obtained should be very deep. Stray capacity to ground in the 1,000 Hz. generator, and other stray capacities, may make a complete null impossible.

Some experience is desirable in learning to adjust this type of bridge so that the student should use well marked condensers for the unknown in order to obtain practice.

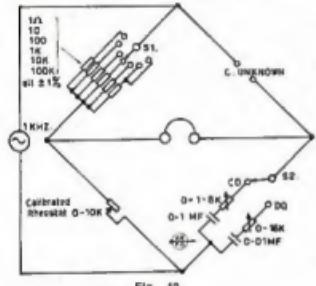


Fig. 10.

THE WHEATSTONE BRIDGE FOR MEASUREMENT OF INDUCTANCE

As the reactance of an inductor varies directly with the inductance, the Wheatstone Bridge can be used for the measurement of inductance in a similar manner as for resistance measurements, if a.c. is used instead of d.c., and an inductance standard is used in place of the resistance standard.

However, in practical bridges for inductance measurement it is not usual to use an inductance for the standard because an inductance may be influenced by external magnetic fields, also in most types of inductors variations in inductance occur as the applied voltage varies. Obviously such variations in inductance are undesirable in a standard.

Fortunately it is possible to use a capacitor in a bridge for the measurement of inductance if the position of the bridge arms are interchanged.

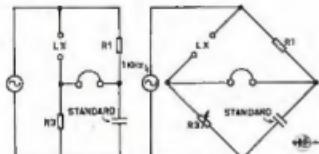


Fig. 11.

It will be noted that the standard reference capacitor and the unknown are in opposite arms (see Fig. 11), thus an increase in reactance in one arm is compensated by a decrease in the other opposite arm and the ratio of the two reactances is given by the ratio of the two resistance arms R1 and R3.

Just as it is impossible to make a capacitor which does not have any losses so it is impossible to make an inductance which does not have losses, therefore with such an inductance bridge as shown, it would be almost impossible to obtain a true null because of the differences in phase shift.

Fortunately adjustable resistances can be added to the arm having the standard so that losses can be added artificially to give the standard arm the same losses as appear in the "unknown" arm. Such resistances can be calibrated to give the energy factor or Q of the unknown inductor.

If such a resistance is connected in series with the standard condenser then the bridge is known as a Hay's Bridge and resistor can be calibrated to read values of Q in excess of 10.

For values of Q less than 10, a resistor is connected in parallel with the standard condenser and this circuit is known as a Maxwell's Bridge.

Two resistances will be required and fortunately one of the resistors used in the capacity bridge may be used for the Maxwell Bridge. The switch for these resistors may be marked LDQ and LQ.

In the LDQ position, the DQ resistor will have a useful range of 160 to 16,000 ohms, and dial controlling

this resistor being calibrated 0 to 10. 0 equals 0 ohms, and 10 equals 16,000 ohms.

Now if the switch is in the LQ position, then a new variable resistor of 0-165 ohms is connected in series with the standard condenser to make the Hay Bridge. The dial for this resistor is calibrated 0 to 10.

The various bridges so far discussed can be made into a single instrument which will measure resistance from 0.01 ohm to 1 megohm; capacitance from 10 pF. to 100 μ F.; with two ranges of power factor 0-0.1 and 0-1; and inductance from 10 microhenries to 100 henries, with two ranges of Q, 0-10 and 0-1,000 respectively.

The audio frequency must be 1,000 Hz.

The bridge just described is basically similar to the very popular General Radio type 650A Impedance Bridge.

As mentioned earlier, stray capacitance in the audio frequency source and the detector may prevent complete nulls being obtained. In professionally made bridges, specially balanced and shielded transformers are used between the audio frequency source and the bridge, also between the bridge and the detector to remove the effects of such stray capacities.

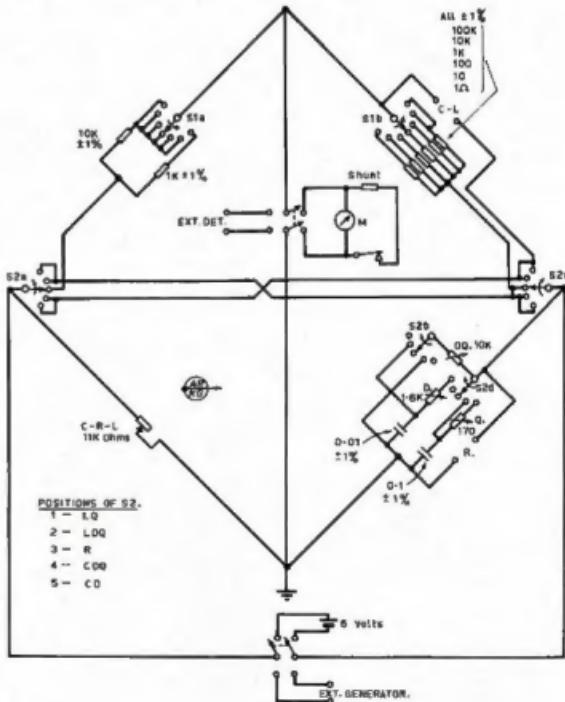


Fig. 12.

Wheatstone Bridges such as these described find considerable use in radio work and the student should become completely familiar with the theory and if possible practice on these bridges.

S1-2 pole, 7 position switch, 2 banks, S2-4 pole, 5 position switch, 4 banks.

Switches preferably ceramic.

All fixed resistances, high stability, $\pm 1\%$.

C-R-L 0-10,000 or 0-11,000 ohms linear w.w. rheostat or potentiometer used as a rheostat. This should be the largest diameter it is possible to obtain. To be fitted with 8" dial as described in the text.

D-0-1,000 ohms linear w.w. rheostat, Q-0-170 ohms linear w.w. rheostat, DQ-0-16,000 ohms linear w.w. rheostat.

If these values are not available, rheostats with slightly larger maximum values can be shunted with suitable fixed resistors to obtain the desired values.

TABLE 1

The seven positions of switch S1 (Fig. 12) should be marked as follows. These markings become the multiplying factors to be applied to the particular calibration marking of the C-R-L dial when a null has been obtained.

Sw. S1

Postn.	C	R	L
1	10 μ F.	0.1 Ω	100 μ H.
2	1 μ F.	1 Ω	1 mH.
3	0.1 μ F.	10 Ω	10 mH.
4	0.01 μ F.	100 Ω	100 mH.
5	0.001 μ F.	1,000 Ω	1 H.
6	0.0001 μ F.	10,000 Ω	10 H.
7	—	100,000 Ω	—

Example.—Assume that when measuring some resistances that S1 is set to position 5 (marked 1,000 ohms) and that a null is found in the C-R-L dial at 7, then $7 \times 1,000 = 7,000$ ohms. If the null was found at 0.7 on the C-R-L dial, then the unknown resistance would be 700 ohms ($0.7 \times 1,000$).

Caution.—Due to the tolerances of $\pm 1\%$ used in the fixed resistances it

istance and capacitance and 15% for inductance.

Precision laboratory bridges will do much better than this and will be corresponding more expensive to manufacture.

TABLE 2

Calibration of the C-R-L dial for the C-R-L rheostat. The rheostat must be not less than 10,000 ohms at maximum resistance and should be not more than 11,000 ohms.

The overall accuracy of the bridge will depend on the accuracy with which the C-R-L rheostat can be calibrated. The dial should be at least 8" in diameter and can be made from a piece of 1/8" flat brass plate, turned to a 8" diameter disc in a lathe, and fitted with a large skirt knob.

There are three ways of making the calibration. The first is to use a high quality ohmmeter. The second is to use another bridge, and the third method is to connect the rheostat in series with a 6 volt battery and an 0-1 mA. meter with shunts to 1 ampere. Measurements of the current flowing in the rheostat are made for various settings of the rheostat and the resistance calculated from Ohms Law.

As it may be difficult to determine the internal resistance of the battery, this should be ignored.

Calibration of the C-R-L Dial

Dial in Ohms	Resist. of Rheostat	Resist. of Rheostat in Ohms
0	0	1,000
0.1	100	2,000
0.2	200	3,000
0.3	300	4,000
0.4	400	5,000
0.5	500	6,000
0.6	600	7,000
0.7	700	8,000
0.8	800	9,000
0.9	900	10,000
—	—	11,000

Intermediate points can be determined from this table.

This switch is marked as follows:

$D = R \times C$	C	R	L	$Q = \frac{R \times L}{R}$
Dial	D	DQ	DQ	Dial
Multipier	0.01	0.1	1	Multiplier

may be found that slightly different values may be obtained for the unknown resistor when adjacent switch positions are used, i.e. assume that the unknown is 1,000 ohms. With S1 on position 5, the C-R-L dial should read 1 ($1,000 \times 1 = 1,000$). If S1 position 4 is used then a reading of 10 should be obtained on the C-R-L dial, $100 \times 10 = 1,000$, but due to the tolerances mentioned above, balance may not be the same although it will be close to it. Commercially manufactured bridges of this type can have accuracies of 1% for resistance and capacitance in the intermediate multiplier ranges and 2% for inductance. However, at the low and high multiplier ranges the accuracies may be only within 5% for re-



ERRATA

"The Nature of Matter," Lecture No. 1, Jan. 1970, "A.R." The centre and right hand drawings on page 9 should each have a dot in the outer circle. Also, on page 10, the symbol for Lithium should be Li and for Silicon Si.

"Electric Current and Ohms Law," Lectures 2 and 3, Feb. "A.R." page 10: In the working out of the example in col. 3, $\dots + \frac{1}{1}$ should be $\dots + \frac{1}{R_4}$

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S.W.R. Indicators—Trick or Treat?

COL HARVEY,* VK1AU

Over the years, experiments with Yagis and Quads have occasionally shown inconsistencies between S.W.R. Bridge readings and maximum radiation as shown by a Field Strength Meter. Although some of these effects can be blamed on feedline radiation, others remain unexplained other than as some inadequacy in the design or location of the s.w.r. meter. Discussion on the air shows that despite such anomalies (which few seem to be aware of) the s.w.r. meter is well regarded by many Amateurs and thought to be incapable of providing misleading information.

The following practical results show that the instrument can confuse and mislead, and that it might be wise to hedge one's bets on the infallibility of assumptions based primarily on s.w.r. readings.

Take the case of a three element plumber's delight on 21 MHz. built to A.R.R.L. formulas except that all elements were intentionally lengthened 5 inches. It was gamma fed, with the s.w.r. bridge at the transmitter end of a 66-foot length of co-ax. A frequency versus s.w.r. run gave the following results:—

21000	KHz.	S.W.R.	2.4
21300	"	"	2.0
21400	"	"	1.8
21500	"	"	1.2

Table 1.

The inference one is entitled to make is that the s.w.r. would drop to a very low value outside the high end of the band, i.e. the array is too short. Let us now lengthen all elements 4 inches. A frequency versus s.w.r. run now gave the following result:—

21000	KHz.	S.W.R.	1.6
21200	"	"	1.8
21300	"	"	1.0
21350	"	"	1.1
21400	"	"	1.2
21500	"	"	1.5

Table 2.

One would now conclude that the array is tuned and properly matched at 21300 KHz. But is it? Results show only fair forward gain, poor directivity and negligible front-to-back ratio. Despite this, the s.w.r. meter says that the array is just fine!

On the basis that a change in inter-element spacing to the optimum values for maximum forward gain might improve matters, and on the assumption that the element lengths were now fairly right, the reflector was moved slightly (to 0.25 wavelength spacing). Result:—

21000	KHz.	S.W.R.	3.2
21100	"	"	3.0
21200	"	"	2.9
21300	"	"	2.6
21400	"	"	2.3
21500	"	"	1.8

Table 3.

Could it be that a small change in inter-element spacing had so seriously detuned the beam that it was now resonating well outside the high edge of the band? Surely, with all elements already 9 inches longer than the formulae it couldn't possibly be true that another 7 or more inches was needed to bring the beam back into the band? If the s.w.r. meter indications were right, then the formulae were about 10% out—a fairly unlikely proposition. Something else must be wrong.

Perhaps the four half wavelengths feeder wasn't 75 ohms? Terminating the feeder with 52 ohms gave an s.w.r. of 1.4. Terminating with 75 ohms gave an s.w.r. of 1. The feeder was 75 ohms all right. At this point an interesting observation was made. If the s.w.r. bridge was set to the 52 ohm position and an s.w.r. versus frequency run repeated, instead of the result in Table 3, the readings became:—

21000	KHz.	S.W.R.	2.3
21100	"	"	2.4
21200	"	"	2.5
21300	"	"	2.7
21400	"	"	2.7
21500	"	"	3.8

Table 4.

Compare Tables 3 and 4. Table 4 suggests that the beam is outside the low end of the band, Table 3 outside the high end! Obviously the shape of an s.w.r. curve doesn't necessarily indicate anything useful.

If anything is to be made of s.w.r. readings it is obviously imperative to start with an almost flat line of a known impedance. Measurements showed that the 66 ft. length of co-ax was in good condition with only 2 db. loss (see A.R.R.L. Antenna Handbook, page 85). It gave a fair resonance dip on the g.d.o. at 21 MHz. (and a very good dip near 14 MHz.—presumably the free space resonant point of the outer shield). With 75 ohms at the far end, s.w.r. was 1:1.

Now to check out the balun. The traditional formula for a co-ax. balun is $462 + F_{\text{MHz}} \times \text{Velocity Factor}$. Assuming 66% for the velocity factor, the length of the balun should be about 15 feet. However, at this length, the g.d.o. showed resonance well above 21 MHz., and it was necessary to add about 3 feet to the co-ax. to reach the correct length for 21 MHz! Apparently the velocity factor of this particular cable

was well above the traditional 66%. The evidence of the g.d.o. seems conclusive, as the observed dip moved smoothly from 28 MHz. to 21 MHz. as the length was increased.

The stage had now been reached where either 75 ohms at the end of the co-ax. feeder, or 300 ohms across the 4:1 balun resulted in an s.w.r. of 1:1. With the feed arrangements proven, the antenna was set up to the lengths required. Using the A.R.R.L. Antenna Handbook, it is possible to select the exact formulae appropriate to the inter-element spacing to be used. With an arbitrary setting on the gamma bar, the first s.w.r. run of the re-arranged array resulted in:—

21000	KHz.	S.W.R.	1.0
21100	"	"	1.0
21200	"	"	1.1
21300	"	"	1.8
21400	"	"	1.7
21500	"	"	2.2

Table 5.

It was difficult to resist the temptation to shorten the antenna elements and so raise the frequency at which the s.w.r. would drop to 1:1. Instead, attention was directed only to the gamma match. The effect of two values of series capacitance was as follows:—

F KHz.	Series Capacitor	
	47 pF.	28 pF.
21000	S.W.R.	1.1
21100	"	1.1
21200	"	1.1
21300	"	1.1
21400	"	1.3
21500	"	1.4

The impedance bridge applied to the end of the co-ax. now showed a good non-reactive type dip at 21200, and read about 70 ohms. Best of all, on-the-air checks showed a significant improvement over the initial condition when despite a low s.w.r., the antenna element lengths were all wrong. According to one on-the-air report the half power points were plus and minus 30 degrees, and the front-to-back ratio 25 db. This is too good to be true, as 12 db seems more likely.

The s.w.r. bridge is now left in circuit partly as an aid to tuning for maximum output, but mainly as a way

(Continued on Page 16)

Design Data for Short and Medium Length Yagi-Uda Arrays

INTRODUCTION

The Yagi-Uda array is a popular method of obtaining directional properties in an antenna. From a constructional viewpoint, particularly simple is the uniform array in which the directors are equally spaced and of the same length. Less simple is the solution to the equation which predicts what the performance of a given array is likely to be. The data presented here have been obtained using an IBM 7090 computer to solve the performance equations for a range of geometrical parameters likely to be of practical significance.

THEORY

There are presently two ways in which the operation of Yagi-Uda arrays can be viewed. One view is to regard the radiation pattern as being the result of the interference between the radiation from the driven element and the travelling wave in the array; the analysis by this method for short arrays is very difficult.

The classical approach develops the radiation pattern from the interaction of the radiation from the driven element and a number of short circuited dipoles. It is easier to write down the equations describing the performance in this case. In fact, if Z is the mutual impedance between some given direction element and the driven element, I is the (complex) ratio of the currents between these two elements, and Y, X, W, \dots are the mutual impedances between the chosen directors and each of the other parasitic elements, for this director—

$$Z = YI + XI + WI + \dots$$

There are as many equations of this type as there are parasitic elements, and the whole set must be solved simultaneously. The mechanics of doing this is fairly standard computer work once expressions for the values of Z, Y, X, W, \dots can be found.

PRESENTATION

All the data presented have been made non-dimensional with respect to wavelength, so figures for spacing, conductor diameter and element lengths are fractions of a wavelength. Reference to Table 1 shows that the following parameters are available:

No. of elements in the array:
3-10

Spacing of elements:
0.15, 0.20, 0.25, 0.30.

Conductor diameter:
0.0025, 0.005, 0.01, 0.02.

Given any combination of these quantities, the entry in Table 1 gives the element lengths and resulting radiation pattern for maximum gain and a purely resistive feed impedance.

The original of this article was a paper published in Electrical Engineering Transactions, Vol. EE2, No. 1, of March 1968. The précis we have below was prepared by Dr. D. R. Blackman, of Monash University. We extend our grateful thanks to the Author of the original paper, Mr. H. E. Green, M.E., of the Weapons Research Establishment, and to the Institution of Engineers, Sydney, publishers of Electrical Engineering Transactions, for their permission to publish this précis and associated tables.

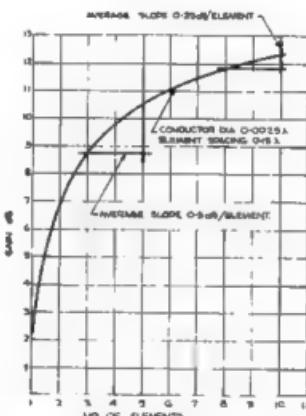


Fig. 1.—Typical Curve of Gain against Number of Elements for Uniform Yagi Array.

STACKED ARRAYS

As is to be expected, the benefit from each succeeding element added to an array decreases. A curve of Gain against Number of Elements is shown in Figure 1; this curve is characteristic of most arrays of the Yagi type. If more gain is wanted than can be obtained with, say, 5 elements, better performance can be more easily obtained by stacking arrays.

If the calculations leading to the results in Table 1 are not to be invalidated, sufficient distance must be left between arrays to preclude interaction between the elements in the separate arrays.

For arrays with the elements co-planar, a centre to centre spacing of not less than 0.75 wavelengths is sug-

gested and for arrays with the elements parallel to spacing of not less than 1.0 wavelength.

PERFORMANCE OF ARRAYS DESIGNED USING TABLE 1

A number of experiments were performed to verify the predictions made in Table 1. The frequency used in these tests was 2.4 GHz. The agreement between theory and experiment was very satisfactory; for more details the reader is referred to the original paper. From a design point of view, these experimental antennae resonate at frequencies 1-2% below the calculated value. In practice, therefore, some slight trimming of elements may be necessary.

The same satisfactory agreement was not obtained with the predicted values of input impedance. The sensitivity of the input impedance of the Yagi is quite notorious, so this lack of close agreement is perhaps not surprising. Moderate mismatching appears to have little effect on the radiation pattern, and in practice the final matching would be made with the aid of a s.w.r. bridge anyway.

In the case when a metallic centre support is used some correction to the lengths of the elements is necessary. A suggested figure is to lengthen elements by $0.75 \times \text{diameter of the support}$; this will tend to give elements which are too long and may consequently need trimming.

Table 1 is shown on page 14 and is continued on page 15.

WORLD'S FIRST COLOUR T.V. TELEPHONE UNVEILED

The world's first colour t.v. telephone has been developed by Tokyo Shibaura Electric Company (Toshiba).

It will be displayed at Expo '70 by the Nippon Telegraph and Telephone Public Corporation.

The device consists of an ordinary telephone for conversation plus a 12" colour picture tube in the centre, with a television camera and a 3" black-and-white monitor tube arranged on it.

The moment the telephone receiver is lifted by the person called, the image of his bust appears on the 12" colour t.v. screen, while the caller can see his own image on the monitor screen.

If the self-view button is pressed, the called speaker's image is replaced with the caller's, enabling him to monitor his own image as viewed at the other end of the wire.

The trial-manufactured set is fairly large, says the Company, 52 centimeters high, 57 centimeters wide and 47 centimeters deep. But Toshiba claims that it can be reduced to about two-thirds by using integrated circuits and smaller picture tubes.

TABLE I.

Tabulation of the Characteristics of Uniform Yagi Arrays.

No. of elements	Spacing	Conductor diameter	Lengths			Front to back ratio (dB.)	Resistance (ohms)	Polar diagram										
			H Plane					E Plane										
			Reflector	Driven element	Directors			3 db. SW	1st Null Position	1st Side lobe Level	3 db. SW	1st Null Position	1st Side lobe Level					
3	0.0025	0.15	0.4931	0.4738	0.4764	9.4	7.8	3.1	68°	71.5°	12.1	9.9	52°	-40.0	118.5°	-22.0		
		0.20	0.4883	0.4659	0.4693	9.8	6.7	7.8	68	70.5	19.2	9.9	52	-39.5	117.5	-22.5		
		0.25	0.4835	0.4599	0.4627	9.5	5.7	12.1	72	70.5	19.0	11.0	52	-39.5	116.5	-23.0		
		0.30	0.4764	0.4513	0.4522	9.6	4.7	18.0	90	78	17.1	9.9	13.0	56	-40.0	115.5	-24.5	
4	0.0025	0.15	0.4883	0.4885	0.4897	9.7	8.5	19.2	71	74	-16.9	98	-12.7	34	96	40.0	112.5	-28.1
		0.20	0.5020	0.4879	0.4910	10.2	14.5	12.1	72	79	-12.9	93	-9.5	48	80	40.0	121	-22.5
		0.25	0.4907	0.4679	0.4621	11.2	13.5	13.5	76	77	-16.4	80.5	-19.4	46	66	-23.3	67	-22.5
		0.30	0.4786	0.4586	0.4595	11.1	7.5	21.5	98	35	-60.0	78.5	-9.9	46	35	40.0	60	-23.2
5	0.0025	0.15	0.5074	0.4802	0.4821	10.2	16.7	14.1	64	64.5	-14.0	95	-10.4	30	90	-40.0	122	-21.0
		0.20	0.4883	0.4694	0.4773	11.2	12.1	18.6	56	54.5	-26.3	76.5	10.2	46	51	67.5	51.5	-21.5
		0.25	0.4812	0.4797	0.4902	11.1	7.6	35.3	56	54	-60.0	77	-9.5	46	54.5	-40.0	68	-21.2
		0.30	0.4835	0.4664	0.4793	12.3	18.6	21.3	66	65	-17.5	65	-8.8	46	45	21.5	59	-16.5
6	0.0025	0.15	0.4955	0.4707	0.4726	11.0	15.7	13.7	58	58.5	-14.5	81.5	-11.1	68	90	-40.0	125	-24.6
		0.20	0.4835	0.4630	0.4545	11.3	8.8	35.4	58	54.5	-26.7	76.5	10.2	46	51	67.5	51.5	-21.5
		0.25	0.4859	0.4662	0.4532	13.3	17.4	21.5	46	68.5	-18.3	65.5	-9.3	47	24.4	59.5	17.5	-19.5
		0.30	0.4764	0.4580	0.4489	11.7	7.2	42.1	48	49	-27.4	64	-8.4	45	35	51.5	59	-18.5
7	0.0025	0.15	0.4859	0.4663	0.4654	11.4	9.3	22.5	54	54.5	-16.4	75	-10.5	46	56.5	-22.3	65	-21.3
		0.20	0.4931	0.4696	0.4652	12.1	21.1	10.9	48	47	-15.9	87	-9.3	42	48.5	-20.1	95.5	-17.5
		0.25	0.4788	0.4654	0.4631	12.1	8.5	40.5	46	45	-36.7	83.5	-9.0	42	45	-40.0	39	-16.7
		0.30	0.4788	0.4611	0.4678	13.0	13.3	29.3	40	39	-24.1	98	-8.6	37	39.5	-26.3	33	-14.5
8	0.0025	0.15	0.4931	0.4704	0.4654	11.5	13.6	28.2	51	51	-16.4	72.5	-9.0	44	52	-21.3	63.5	-19.1
		0.20	0.4859	0.4627	0.4607	12.4	29.3	29.3	48	49.5	-32.8	94	-9.5	42	46	-20.5	95.5	-17.5
		0.25	0.4819	0.4637	0.4778	12.2	24.6	30.4	46	47	-17.4	84	-9.5	42	45	-20.5	39	-16.7
		0.30	0.4838	0.4667	0.4662	13.0	30.4	30.4	33	32	-24.1	98	-12.3	33	34.5	-34.0	47.5	-11.5
9	0.0025	0.15	0.4931	0.4715	0.4607	12.1	25.0	17.5	68	47.5	-16.0	67	-9.7	42	49.5	-20.4	60.5	-18.2
		0.20	0.4931	0.4721	0.4678	12.4	24.3	22.1	48	39.5	-13.4	84	-9.5	42	46.5	-20.5	62.5	-17.5
		0.25	0.4889	0.4648	0.4627	12.1	25.0	22.1	48	39.5	-24.3	84	-9.5	42	45	-20.5	29.5	-15.5
		0.30	0.4794	0.4579	0.4647	13.4	9.8	39.3	37	35	-35.1	49.5	-8.3	42	34.5	-34.0	47.5	-12.5
10	0.0025	0.15	0.4907	0.4644	0.4375	12.5	13.4	22.9	46	46	-19.5	64.5	-9.7	42	45.5	-21.3	59.5	-17.5
		0.20	0.4859	0.4648	0.4467	12.5	25.0	22.5	48	48.5	-20.5	37	-9.0	42	45	-22.3	52.5	-14.8
		0.25	0.4812	0.4654	0.4467	13.7	20.0	20.2	37	35.5	-31.0	38	-8.7	36	23.2	-47.5	13.4	-13.5
		0.30	0.4788	0.4624	0.4545	14.1	18.8	31.1	32	31	-17.6	44	-7.7	30	31	-19.1	42.5	-11.5
3	0.0050	0.15	0.4912	0.4686	0.4723	9.4	7.6	2.9	68	70.5	-12.2	96	-9.8	52	90	-40.0	117	-22.0
		0.20	0.4885	0.4603	0.4629	9.8	7.2	7.9	69	72	-19.0	99.5	-11.5	53	90	-40.0	115.5	-23.5
		0.25	0.4794	0.4530	0.4510	9.5	6.3	18.4	78	60	-40.0	100.5	-13.8	56	84	-40.0	115	-25.0
		0.30	0.4767	0.4449	0.4416	8.7	3.1	39.7	31	78.5	-16.2	99	-13.0	59	99.5	-40.0	114.5	-26.9
4	0.0050	0.15	0.4865	0.4593	0.4534	9.7	8.4	19.0	70	74	-17.1	98.5	-12.0	54	90	-40.0	115	-26.7
		0.20	0.5030	0.4741	0.4629	10.2	15.9	11.4	64	64.5	-12.3	88.5	-10.2	49	90	-40.0	123.5	-21.2
		0.25	0.4865	0.4628	0.4528	11.3	13.7	12.7	56	57	-16.0	79.5	-10.4	46	50.5	-40.0	125.5	-21.5
		0.30	0.4747	0.4590	0.4603	11.1	8.4	21.7	57	57	-60.0	79	-10.5	50	50	-40.0	94.5	-23.5
5	0.0050	0.15	0.5054	0.4764	0.4588	10.2	17.0	13.3	64	67	-19.8	94.5	-10.6	50	90	-40.0	123	-21.0
		0.20	0.4865	0.4616	0.4687	11.3	13.3	14.7	64	56.5	-16.3	87	-11.8	47	51	-40.0	124.5	-21.5
		0.25	0.4770	0.4514	0.4616	11.1	7.9	31.1	58	55	-37.0	77	-9.7	47	46.5	-40.0	126.5	-21.5
		0.30	0.4717	0.4592	0.4510	12.3	13.4	13.4	64	44	-36.0	94.5	-8.5	40	43	-20.5	58	-16.1
6	0.0050	0.15	0.4912	0.4523	0.4463	11.0	15.1	12.3	57	59	-13.5	78	-10.9	48	90	-40.0	124.5	-23.4
		0.20	0.4865	0.4644	0.4622	11.0	19.0	9.7	58	58	-19.6	94.5	-10.4	49	90	-40.0	125.5	-23.4
		0.25	0.4841	0.4599	0.4463	12.3	19.6	40.2	46	45	-45.5	64.5	-9.0	48	46	-20.8	98.5	-16.8
		0.30	0.4723	0.4487	0.4369	11.7	7.2	40.6	48	45	-27.4	64	-8.4	42	45	-31.9	39	-14.5
7	0.0050	0.15	0.4865	0.4605	0.4322	11.4	11.3	20.5	56	56.5	-18.7	78	-11.2	47	58	-20.8	68	-23.4
		0.20	0.4865	0.4631	0.4440	12.2	10.8	27.8	46	46	-14.4	65	-9.0	42	45	-18.4	58	-18.8
		0.25	0.4770	0.4535	0.4345	12.1	0.8	40.2	46	45	-36.5	63.5	-8.9	42	45	-20.0	58	-16.5
		0.30	0.4767	0.4550	0.4390	13.0	13.6	28.3	40	38	-24.6	98	-8.7	40	37	-27.3	53	-14.5
8	0.0050	0.15	0.4936	0.4756	0.4992	11.5	15.1	24.5	46	47.5	-15.7	71.5	-8.8	44	53	-19.8	62.5	-18.5
		0.20	0.4817	0.4585	0.4522	12.2	10.8	22.0	40	39.5	-22.0	63.5	-9.5	41	46	-25.5	59	-17.2
		0.25	0.4747	0.4576	0.4295	12.8	9.2	42.3	40	39	-17.8	59.5	-8.5	42	36	-20.5	52	-14.2
		0.30	0.4794	0.4627	0.4322	13.3	10.1	39.0	37	35	-35.3	49.5	-8.2	34	35	-16.7	46	-11.7
9	0.0050	0.15	0.4912	0.4663	0.4322	12.1	24.5	16.5	48	47.5	-15.7	66.5	-9.7	42	48	-20.1	59.5	-18.1
		0.20	0.4888	0.4673	0.4392	12.7	23.8	20.0	40	39.5	-18.8	61.5	-8.1	36	40	-18.8	52	-13.9
		0.25	0.4747	0.4557	0.4295	12.8	9.2	42.3	40	39	-31.5	54.5	-8.7	37	34	-35.5	51.5	-14.2
		0.30	0.4747	0.4507	0.4322	13.3	10.1	39.0	37	35	-35.3	49.5	-8.2	34	35	-36.2	47.5	-12.8
10	0.0050	0.15	0.4865	0.4613	0.4227	12.5	13.5	20.7	46	46	-20.0	64.5	-10.0	42	47	-21.7	60	-18.0
		0.20	0.4861	0.4581	0.4296	12.3	14.7	24.8	40	39.5	-18.8	55	-8.9	42	45	-21.4	52	-14.6
		0.25	0.4817	0.4559	0.4345	13.8	15.5	27.1	36	34	-17.2	54.5	-8.1	33	34	-30.5	46.5	-12.4
		0.30	0.4770	0.4563	0.4368	14.0	18.8	30.5	33	31	-17.4	43.5	-7.7	30	31	-18.1	42.5	-11.3
3	0.0100	0.15	0.4896	0.4624	0.4640	9.4	3.1	70	74.5	72.1	-12.1	95.5	-10.6	54	90	-40.0	117.5	-22.5
		0.20	0.4828	0.4518	0.4392	9.5	2.5	69</										

TABLE L-(contd.)

No of elements	Spacing	Conductor diameter	Lengths			Gain (db.)	Resonance (ohms)	Polar diagrams										
			Front to back ratio					11 Plane				E Plane						
			Reflector	Driven element	Director			3-dB BW	Position	1st Null	1st Side lobe	3-dB BW	Position	1st Null	1st Side lobe			
7	0.15	0.0100	0.4853	0.4922	0.4197	11.4	11.1	19.4	56°	58.5°	19.6	77.5°	- 11.2	47°	58°	22.6	66°	- 23.2
	0.20		0.4873	0.4941	0.4261	11.4	11.1	19.4	56°	58.5°	19.6	77.5°	- 11.2	47°	52	22.6	66°	- 18.0
	0.25		0.4710	0.4441	0.4220	12.1	8.6	37.7	46	- 36.3	63	- 8.9	43	46	- 19.8	59	- 16.4	
	0.30		0.4710	0.4432	0.4200	13.0	12.0	25.8	40	22.2	55	8.4	38	39	- 24.7	52.3	- 14.0	
8	0.15	0.0100	0.4843	0.4692	0.4206	11.5	13.3	20.2	30	46.5	14.2	71	8.7	44	52	19.0	61	- 18.0
	0.20		0.4780	0.4477	0.4173	12.4	11.4	25.7	46	56.1	66	- 9.7	42	48	27.3	52.5	- 17.5	
	0.25		0.4780	0.4491	0.4267	13.1	16.9	23.2	40	39	18.4	52.5	8.6	36	39.5	21.0	52.5	- 14.3
	0.30		0.4793	0.4529	0.4337	13.2	28.1	25.3	34	33	- 13.7	48	7.2	33	33	15.7	45.5	- 11.3
9	0.15	0.0100	0.4873	0.4593	0.4173	12.4	18.9	13.5	48	50	- 19.2	67.5	11.8	62	51	23.8	62	- 20.7
	0.20		0.4873	0.4569	0.4267	12.7	23.0	21.9	40	40	- 14.4	56.5	8.2	37	40.5	17.2	52.5	- 14.1
	0.25		0.4886	0.4468	0.4173	12.9	9.1	41.2	60	38	28.0	94.5	8.5	36	38.5	20.5	42	- 14.0
	0.30		0.4886	0.4397	0.4197	12.4	9.4	35.7	36	35	29.2	49	9.3	34	31	31.2	47.5	- 12.5
10	0.15	0.0100	0.4826	0.4537	0.4103	12.5	12.9	19.9	46	46	18.9	66	9.8	42	46.5	22.5	59	- 17.6
	0.20		0.4803	0.4500	0.4150	13.3	15.5	23.4	40	40	19.9	55.5	9.1	37	40	22.6	52.5	- 14.8
	0.25		0.4756	0.4693	0.4197	13.7	38.4	26.6	36	35	19.9	69.5	8.3	34	35	21.9	47.5	- 13.0
	0.30		0.4710	0.4468	0.4343	14.3	18.3	28.0	32	31	16.6	44	7.7	30	31	18.4	43.5	- 11.3
3	0.15	0.0300	0.4840	0.4502	0.4545	9.4	7.9	2.6	68	71	12.4	97	10.0	53	90	- 40.0	116.5	- 22.5
	0.20		0.4677	0.4263	0.4269	9.5	6.2	15.0	73	74	15.9	99	11.5	53	90	- 38.0	113.5	- 21.5
	0.25		0.4677	0.4132	0.4132	8.7	4.8	28.9	79	77	16.8	99	12.9	52	78	- 40.0	82	- 38.8
	0.30		0.4564	0.4181	0.4132	8.7	4.8	28.9	79	77	16.8	99	12.9	52	78	- 40.0	113	- 21.5
4	0.15	0.0100	0.4771	0.4364	0.4269	9.8	8.6	18.0	70	74.5	17.8	99	12.7	34	90	- 40.0	115	- 24.8
	0.20		0.4677	0.4593	0.4699	10.3	15.3	7.8	59	62	10.9	81.5	9.8	39	40	- 40.0	134	- 21.0
	0.25		0.4771	0.4411	0.4315	11.2	15.6	10.9	56	57	16.0	79.5	10.5	46	60.5	- 22.6	66	- 23.3
	0.30		0.4612	0.4267	0.4261	11.3	7.8	17.4	56	55	40.0	78	9.7	46	55.5	- 60.0	68.5	- 21.5
5	0.15	0.0100	0.5023	0.4967	0.4338	10.2	16.8	9.3	62	66	12.4	99	10.7	50	90	- 40.0	122.5	- 21.7
	0.20		0.4795	0.4384	0.4226	11.2	12.6	12.6	56	56.5	16.0	78	10.6	46	60	- 22.5	57.5	- 21.3
	0.25		0.4634	0.4252	0.4169	11.1	7.6	23.2	56	58	38.0	77	9.7	48	55	- 60.0	68	- 21.3
	0.30		0.4660	0.4363	0.4246	12.5	15.6	44	46	46	38.5	64	8.4	46	45	- 20.1	38	- 16.1
6	0.15	0.0100	0.4963	0.4459	0.4155	11.0	16.4	11.1	58	60	14.9	81	11.4	48	90	- 40.0	126	- 21.9
	0.20		0.4860	0.4366	0.4156	11.3	8.7	30.4	54	54	25.6	76	10.0	46	54	- 29.8	67.5	- 21.3
	0.25		0.4725	0.4566	0.4178	12.5	14.9	16.5	46	45	16.0	64	9.0	46	46	- 20.6	59.5	- 18.7
	0.30		0.4749	0.4436	0.4297	12.9	15.0	36	34.5	34.5	9.4	51.5	6.0	36	36	- 11.7	66.5	- 10.6
7	0.15	0.0100	0.4771	0.4381	0.4395	11.4	11.1	17.9	56	56	19.7	77.5	- 11.1	47	57.5	- 25.4	68	- 23.0
	0.20		0.4817	0.4428	0.4132	22.2	20.2	15.5	46	46.5	15.1	65.5	9.3	45	48	- 19.2	59.5	- 17.2
	0.25		0.4771	0.4428	0.4158	22.2	24.8	24.8	46	45	32.0	63	8.3	45	45	- 28.0	59	- 16.5
	0.30		0.4612	0.4290	0.4067	13.0	12.9	25.8	40	39	23.7	55.5	8.6	36	39	- 29.7	53	- 14.2
8	0.15	0.0100	0.4868	0.4589	0.4100	11.8	16.7	17.1	30	49	13.0	70.5	- 8.8	44	52.5	- 18.6	80.5	- 17.9
	0.20		0.4777	0.4325	0.4325	13.0	17.3	23.4	46	46	25.5	65.5	9.8	44	46	- 25.6	59.5	- 17.3
	0.25		0.4703	0.4325	0.4325	13.0	12.9	23.4	46	46	25.5	65.5	9.8	44	46	- 25.6	59.5	- 17.3
	0.30		0.4657	0.4393	0.4155	13.2	22.9	22.9	36	33	13.4	47.5	7.2	33	33.5	- 15.3	62.5	- 11.3
9	0.15	0.0100	0.4840	0.4459	0.4095	12.2	22.7	13.9	48	47.5	15.4	66	9.7	42	49	- 25.4	68	- 23.0
	0.20		0.4817	0.4491	0.4095	12.2	30.5	40	40	40	14.0	57	8.3	41	48	- 19.2	59.5	- 17.8
	0.25		0.4840	0.4459	0.4372	12.9	9.3	38.5	46	38	26.7	54	8.4	36	36	- 24.6	51	- 15.8
	0.30		0.4566	0.4237	0.3972	13.4	9.8	32.0	37	35	33.5	49.5	8.3	34	35	- 34.3	47.5	- 12.7
10	0.15	0.0100	0.4771	0.4303	0.3958	12.5	13.4	17.7	46	46	20.2	64.5	- 10.0	42	47	- 23.7	59.5	- 17.7
	0.20		0.4726	0.4358	0.3927	12.5	14.4	21.0	40	40	19.6	53.5	- 9.1	37	40	- 23.5	54.5	- 14.8
	0.25		0.4680	0.4330	0.3995	13.8	17.5	23.2	36	34.5	17.9	48.5	- 8.3	33	35	- 20.0	47	- 12.6
	0.30		0.4657	0.4311	0.4041	14.2	18.1	25.8	32	31	16.0	44	- 7.7	30	31	- 18.5	42	- 11.2

S.W.R. INDICATORS

(Continued from Page 13)

of knowing if some mechanical fault has developed in the feeder. A short across the far end of the feeder will show only about 2:1.

GUIDE LINES

On the basis of this project, the following guide lines seem relevant:

• **Element Spacing.**—Go for wide spacing, reflector at least 0.2 wavelength, director 0.25 wavelength. This can replace the 2 db. loss inherent in co-ax. feedline.

• **Driven Element.**—There is a great temptation to set it to resonance using a radiated signal and a diode meter combination across intended feed point. Don't do it! For gamma feed, the radiator needs to be a little short.

• **Reflector.**—Too much enthusiasm for front-to-back ratio will reduce forward gain slightly. But even the best front-to-back ratio will

only cost you about 3 db. in forward gain. In VK it's usually best to go for maximum forward gain.

• **Gamma Bar.**—Increasing the spacing of the bar from the radiator raises the impedance range of the bar. Also shortening the radiator will raise the antenna feed point impedance. Since a lot of work will be needed to optimise the options available, it's better to rely on the formulae for radiator length, fiddling only the gamma match for maximum radiated signal. Don't forget to provide some series capacity to offset the inductive reactance of the gamma bar.

• **Design Frequency.**—Design and tune up on a frequency 100 KHz. lower than the spot you wish to operate on most. The array will increase in frequency when raised above ground to its intended operating height.

• **Test Equipment.**—Use a simple Antenna Bridge, a G.D.O., and a remote indicating Field Strength Meter, initially. Rely on these, rather than a S.W.R. Bridge.

TECHNICAL ARTICLES

Readers are requested to submit articles for publication in "A.R." in particular constructional articles, photographs of stations and gear, together with articles suitable for beginners, are required.

Manuscripts should preferably be typewritten but if handwritten please double space the writing. Drawings will be done by "A.R." staff.

Photographs will be returned if the sender's name and address is shown on the back of each photograph submitted.

Please address all articles to:

EDITOR "A.R."
P.O. BOX 36,
EAST MELBOURNE,
VICTORIA, 3002

REPORT TO FEDERAL COUNCIL (1970)

Gentlemen

It is my pleasure to present the report on behalf of the Federal Executive on its activities during the 1969 Federal Convention. Whilst our financial year now ends on the 31st December, this report deals with the activities of the Federal Executive to date.

To present this report gives me particular pleasure for two reasons. Firstly, I believe that we can report to you that this year has been one of the most successful and productive in the history of our Federal organisation. Secondly, successful year just passed is a fitting start for 1970, the year that marks the 100th anniversary of the wireless amateur of Australia, and I have every reason to believe that 1970 will be a year more successful than the year just passed. In my mind there is no doubt that an active and effective organisation must continue to attract more and more amateurs, and hope to be active and effective without the wholehearted support of the Australian Amateur population. I now turn to particular topics.

• 1969 NZ.A.R.T. BI-CENTENARY CONFERENCE AT GIBSONE

The Federal Council resolved, at the 1969 Federal Convention, to accept the invitation of N.Z.A.R.T. to represent at this most important Conference, and it was my privilege to represent you there. I was invited to address the Conference, which I did on Saturday, 31st May. A copy of this address is in the reproduction in "Gibson", the official journal of N.Z.A.R.T., as well as in our own journal, "Amateur Radio". After my return on 26th June, 1969, I reported in detail to the Federal Council on this visit. The personal contact with this visit provided a refreshingly frank and helpful exchange of views and, I believe, a far better understanding between the two organisations. More tangibly, it also resulted in the exchange of 1000 W.L.C. By February, 1970, we were sending 23 copies of "Amateur Radio" to our New Zealand subscribers, N.Z.A.R.T. handling the subscriptions at a special rate for its members. The personal contact initiated by this visit has continued, and I am able to keep fairly regular "skeds" on 20 metres with the N.Z.A.R.T. President, Bill Hamer ZL8CD May 1, in this report, once again records my deep appreciation for the courtesy and kindness that I received from the New Zealand Amateurs whilst I was in their country.

One matter that is to be raised at this Federal Convention is the possibility of altering the rules for the Remembrance Day Contest to enable New Zealanders to participate. I believe that a favourable decision by the Federal Council on this matter would be very much appreciated by the New Zealand Amateurs, so many of whom express to me their desire to participate in this, the premier Contest in our part of the world. Their participation can only serve to bring our two Societies even closer together, which I believe is in the interests of both organisations.

• REPRESENTATION

At the 1969 Federal Convention, the Federal Council expressed the view that closer personal contact between the Federal Executive and the Divisions desired to have taken the opportunity that had been open to me to pursue this policy, as I believe that without continuing personal contact our activities in the Federal sphere can be seen so easily as something remote and distant from our membership in the context of my own home from New Zealand. I met and conferred with the Federal Councillor of the New South Wales Division, and the President of the New South Wales Division. On Friday, 18th October, I addressed a Council meeting of the South Australian Division in Adelaide, and on the following day I met a number of the members at the home of the Federal Councillor for that Division. On 4th November, I addressed and opened the joint Convention held in Albany by the adjacent Victorian and New South Wales Zones. On 11th October, in the course of a visit to Sydney, I conferred with the Council of the New South Wales Division, and on the follow-

ing day conferred with the Federal Reporter Secretary.

On Friday, 30th November, I addressed a General Meeting of the Queensland Division in Brisbane, and on the following Monday (1st December) I met the Council of that Division. On 1st December, I addressed a General Meeting of the Victorian Division. The total cost to the Institute of these visits to the Divisions has amounted to approximately \$160. I believe that continuing personal contact between the Executive and the Divisions throughout the year is of fundamental importance. It is too easy for the Federal Executive to be seen as seven faceless men, remote from the everyday life of Amateur Radio. What our General Organisation is doing is of basic importance to all Amateurs. Our Federal body represents all Amateurs everywhere, and an understanding of these activities can only come from personal contact.

To the Executive, I have acquired a far deeper insight of the peculiar problems that face each Division that I have visited. I am quite convinced that many of the conflicts and misunderstandings of the past would have been avoided if there had been better communication in these times. I believe that it is in the interest of our organisation for the future that this contact continues.

To the Federal Councillors, to the Presidents, in the Councils, and to the members of the Divisions that I was able to visit in the last year, may I express my appreciation of their hospitality, patience and courtesy.

• THE YEAR AHEAD

A considerable amount of time and effort has been devoted to planning for 1970. The Australian Tourist Commission provided, free of charge, 180,000 blank QSL cards for distribution to Australian Amateurs through the Divisions. The total number, large as it was, merely the start for a further 180,000 cards were printed, using the plates prepared for the Australian Tourist Commission, the printing of which was paid for by individual members. To the Australian Tourist Commission, I extend our gratitude, thank you for their generous support, enabling us to supply many Amateurs with such attractive cards.

The rules of the Cook Bi-Centenary Award were published in August "Amateur Radio", and a handsome Certificate was produced, and was featured on the front cover of the January "Amateur Radio". Copies of the rules of this Award were circulated to over 2000 overseas societies and publications. A thousand copies of the Cook Bi-Centenary Award Certificate have been printed. It is our hope that the number of Certificates printed will prove to be quite insufficient and it seems that this is quite likely. In addition, from 1st January, 1970, at the end of 1970, Australian Amateurs are permitted to use the alternative prefix "AX". and the use of this prefix is an integral part of the rules of the Cook Bi-Centenary Award.

The use of the Award and the "AX" prefix became immediately obvious on 1st January, 1970. I think we have all been surprised at the very real interest that has been created in this prefix. It is my opinion and that of the Award Manager that the use of this prefix has created more activity than any other single thing for many years.

The rules of the Cook Award have been the subject of some discussion. They have been tailored to provide an award attractive to overseas Amateurs. Various suggestions have been made and the specific sections of the Award Executive has accepted the advice of the Awards Manager, that such sections would merely complicate the rules to serve a very small minority at the expense of sacrificing basic simplicity. In this decision, however, it is however to be required, though because of the diversity of views as to how the rules for such an award should be framed, the formulation of the rules for such an award has presented considerable difficulties. This matter has been left in the hands of the Federal Vice-President and the Awards Manager, and will be decided by Federal Council at the Federal Convention.

The role to be played by Divisions in 1970 is under investigation. I would like to ask all Divisions to plan their activities for this year bearing in mind the special significance of this year for Amateur Radio, particularly highlighting the 80th Anniversary of our organisation.

• CONFERENCE FOR SPACE TELECOMMUNICATIONS

As you know, a World Administrative Radio Conference for Space Telecommunications has been set down to open in Geneva in June 1971. The significance of this Conference cannot be underestimated and on its own initiative, Federal Executives had prepared and distributed a memorandum and comprehensive report to Federal Council. It will be the task of the 1970 Federal Convention to formulate the Institute's policy in relation to the 1971 Conference.

The report prepared by Federal Executive was the product of a week end in November when various persons were consulted. In addition, considerable amounts of material were analysed in the report to assist the Federal Council in reaching a view. Federal Executive has suggested a policy for consideration by Federal Council as a tangible starting point in a considerable number of areas. It is a very considerable part of the Executive's time during the past few months, sometimes to the detriment of other matters, but I think the importance of this Conference has more than justified the time that has been spent in it. Whilst June 1971 may seem to be a long way in the future, there is no alternative to early preparedness.

I would like to thank the Federal Council, of those Divisions that submitted material, to the members of the Federal Executive who in preparing the report, the Federal Reporter and the members of the W.L.C. Project Australia, and the very many other people who gave of their time to offer their views and expertise to the Executive.

• "AMATEUR RADIO"

Whilst the Institute's publications will be the subject of a separate report from the Editor, Mr. Ken Pincott (who is now a member of the Federal Executive), I would like to observe in passing how many people have commented to me on the greatly improved standard that has been attained by our magazine during the past year. The additional funds obtained through the last price increase have been utilised to excellent advantage, and I am sure that all our subscribers will join me in offering our congratulations on a job well done.

It is gratifying to be able to report that for the first time this year, articles published in "Amateur Radio" are being reprinted by other journals, including "Radio Communication", "CQ Magazine" and the journal of the Dutch Amateur Radio Society.

"Amateur Radio" is the only direct means of communication the Executive has to our Australia-wide membership. I have attempted, in writing "Federal Comment", to deal with tangible subjects of current concern. I have never realised how hard it is to write "Federal Comment" over so many years. I think the task has been made a little easier because there have been so many topics eminently suitable for writing about. I have been heartened by the fact that so many people do, in fact, read "Federal Comment" and are prepared to base their views on the matters there raised.

• MEMBERSHIP

The following table has been compiled based on membership figures as at 30th December, 1969:—

	* Members				
	Total Licen-	Full Mem-	Membr.	Total Licen-	Assoc. Total
	see	see	see	see	see
VK2	1853	1881	55%	460	1381
VK3	1838	929	50%	276	1196
VK4	100	100	100%	0	0
Inc. VK5	320	320	100%	148	468
VK5	348	418	58%	348	850
VK6	463	382	61%	88	379
VK7	320	145	64%	114	300
Totals	8904	2169	54%	1336	4486

Whilst it is to be expected that the smaller Divisions are able to attract a higher percentage of membership from their total licensees, the percentage of membership in Victoria and Queensland is disappointing. Certainly Queensland has a dimly defined Division and a population spread over a thousand miles. On the other hand, no such excuse is available to Victoria and I regard the Victorian figures as frankly disappointing. It is obvious that the New South Wales Division is considerably assisted by the large Associate membership and here again the Victorian figures compare unfavourably with the New South Wales figures.

Our total percentage of full members against total licensees of 54% is obviously capable of improvement. On the other hand these figures are favourable when compared with overseas societies. It is interesting to note, for example, that N.Z.A.R.T. attracts only a 48% membership. I can see no reason why we should not aim for a 60% membership and I commend this to the consideration of Divisional Councils.

FEDERAL CONSTITUTION

Following the resolution of the Federal Council to change the financial year of the Institute to the calendar year to enable the easier preparation of accounts for the Federal Convention, the following amendment to the Federal Constitution was passed, all Divisions voting in favour of the amendment.

PROPOSED NEW FEDERAL CONSTITUTION

As you will recall, the last outstanding matter that concerned the Divisions in relation to the Memorandum and Articles of Association of the proposed Federal Company was the Amendment to the Constitution for postal interests of all members throughout Australia on the request of two Divisions, notwithstanding a decision of a majority of Divisions. For legal reasons, the inclusion of the provisions was impossible in Victoria. Mr. Federal Council in the 1969 Convention resolved to ascertain whether a different attitude would be adopted by the appropriate authorities in New South Wales. I believe that the New South Wales Division has now advised that a similar attitude would be adopted in that State. The matter was left on the basis that the new Federal body would be incorporated omitting these provisions if that occurred. I have asked the New South Wales Division to advise me of their attitude in the circumstances now existing and I am awaiting their reply. I am very hopeful that once the Constitution Committee of the New South Wales Division has considered the matter, the appropriate authorities will proceed with further delay. Then what is left to be done is of a machinery nature only and the speed of incorporation will be dependent entirely on how quickly the Divisions are able to formally execute the documents at a meeting of their Council.

The incorporation of the Federal Company, with the subsequent transfer of the Institute's properties to the Federal body will place, in the forthcoming year, if it occurs, a heavy additional load on the Federal Executive. In particular, it will impose a heavy load on the Federal Treasurer and the Treasurer of the Divisions, as the arrangements that must be made will be largely of a technical accounting nature.

I.T.U. FUND

The following amounts were to be contributed by each of the Divisions to establish this fund:

New South Wales	.....	\$3,000
Victoria	.....	\$1,000
Queensland	.....	\$600
South Australia	.....	\$1,100
Western Australia	.....	\$400
Tasmania	.....	\$400

At this time a total of \$8,738.87 is held in the fund with all but the Divisional funds except the New South Wales Division having exceeded their quota. Of its target of \$3,000, the N.S.W. Division has paid to Federal Executive \$3,888.

I.A.R.U. REGION III.

During the year, the Interim Constitution of the I.A.R.U. Region III Association was agreed on behalf of Japanese Amateur Radio League, The Philippines Amateur Radio Association, the New Zealand Amateur Radio Transmitters, and the Wireless Institute of Australia, and thus this organisation came into formal being.

No communications were received, however, from Robert W. Denniston, the President of I.A.R.U. The Region III Association is the subject of a separate report from the Region III Director, Mr. John Battwick and apart from the administrative work of our aim in formally creating an organisation within Region III, I leave this matter to his report.

LIAISON WITH AUSTRALIAN POST OFFICE

Throughout this year, our relationships with the Central Administration of the Postmaster General's Department have been cordial in the interests and I would like to record the Federal Executive's appreciation of the assistance it has received from those officers responsible for the administration of the Amateur Service; in particular, Mr. E. J. Wilkinson, the Assistant Director-General (Radio), and Mr. G. C. Cawley, who was responsible for the work towards the end of 1969, was the Controlling Radio Branch. At the annual dinner of the Victorian Division, I presented Mr. Carroll with a hand-made desk set to record the Institute's appreciation of his services during his years in office. I am sure that the close relationship that we enjoyed with Mr. Carroll will continue with his successor, Mr. Young, who was previously Superintendent Radio for New South Wales.

The retirement of Mr. Carroll resulted in some delays as Mr. Young did not take office in his new appointment until early this year.

One matter that has caused considerable concern is the question of repeaters. In 1968 an agreement was reached with the Department on this question, but the matter has been reviewed by the Central Administration. They have been reluctant to license repeaters and have indeed been somewhat doubtful as to the basic principle of repeaters. The Executive has continued to try and reach satisfactory finality on this matter and I am hopeful that this will soon be achieved. It is unfortunate that this has occurred as it has resulted in some difficulty in the appointment of Repeater Secretariat. We intend to confer with Mr. Young just prior to the Federal Convention and I am hopeful that we will be able to report further to the Federal Council.

The question of metering points raised by the South Australian Division has been satisfactorily resolved, as have a number of other minor points.

I am also very pleased to report to you that the Department is very conscious of the hardship caused by the delays in the marking of examination papers for Amateur Proficiency Certificates and have streamlined their procedure. They have indicated that there are efforts to be advised of unavoidable delays and I am sure that every effort will be made to ensure that delays will be kept to a minimum.

Another matter that was successfully concluded was the Institute's suggestion that VK3Q call signs should be allocated according to geographical area. Details of relevant arrangements have already been published.

The question of utilisation of W.I.C.E.N. organisations for other than emergency purposes was raised with the Department. The Department's position is that the activities such as the assistance of charitable organisations should not take place on Amateur bands.

Preparation for the World Administration Radio Communications Conference for Space Telecommunications, on which I have reported elsewhere, has involved a number of discussions with the Department. Under the present heading I would simply observe that the Assistant Director General (Radio) has indicated that it is his wish that the fullest possible consultation with the Amateur Service should take place. I believe that the sort of consultation contemplated is in the best interests of all concerned.

ILLEGAL OPERATION

The 1969 Federal Convention discussed the apparently illegal operation by some persons in the 27 MHz so-called "citizen band". During the year it appeared that this sort of operation was still continuing and the Department and a conference was held with representatives of the Department early this year. Whilst these frequencies are not allocated to the Amateur Service, the identification of these barkings via Amateur equipment in the general public is a matter of legitimate concern. I believe that the Department will do all in its power to stamp out this sort of operation, which serves only to bring the law into ill repute and it causing friction amongst Amateurs.

COMMITTEE TO ASSIST FEDERAL EXECUTIVE

At the 1969 Federal Convention the Federal Councillor for the N.S.W. Division indicated that his Division was anxious to render assistance in the Federal sphere. The Federal Executive considered this offer and suggested to the Division that a committee be appointed to assist the Federal Executive by undertaking specific tasks referred to it by the Federal Executive. The first task referred to this committee was Item 16 of the 1969 Federal Convention relating to the specification of standards for solid state television receivers used in Australia, with the view to the adoption of standards to determine the minimum susceptibility to cross modulation. The report and recommendations of this committee, composed of members of the N.S.W. Division, will be circulated to Federal Council. I would like to thank those members of the N.S.W. Division who are giving their time to assist the Federal Executive in this manner.

The basis upon which a permanent committee to assist the Federal Executive should be appointed has been discussed with the N.S.W. Division Council, it being suggested by Federal Executive that such a committee could be appointed on a basis similar to the appointment of the Federal Repeater Secretariat. However, I am advised that this matter is still receiving consideration by Federal Executive on a purely basis as to securing both the interests of the Division concerned and also recognising the Federal nature of such an activity.

I also believe that a permanent committee available to assist the Executive on specific tasks will be very useful and indeed the existence of this principle in other Divisions would seem to be worthwhile. As opportunities arise where such committees can undertake specific tasks which both reduces the work load on the Executive and enables the involvement of more people in Federal sphere.

W.I.A. PROJECT AUSTRALIS

During the year, to the Institute's great benefit, the Project Australis Group became an integral part of the Wireless Institute of Australia. I am sure the large number of the members of this group will result in much favourable publicity for Amateur Radio generally after the successful launching of the Australis Oscar 3 satellite on 33rd January, 1970. It is important to report to you in detail now on the launch of the subsequent successful operation of the satellite, for this has been covered in detail elsewhere. It is however, appropriate to mention the co-operation of the Institute in relation to the Postmaster General's Department, the Communications Commission, and the Australian Broadcasting Commission which enabled VK3W1 and VK3W1 to broadcast the launch. Both broadcasts were highly effective and those responsible are to be congratulated.

In this report it is simply necessary for me to record our appreciation of the assistance and support we have received from the leaders of the group, in particular Mr. Richard Tonkin, Mr. Kevin Mack and Mr. Les Jenkins.

It should be noted that those accepting the group as a part of the Institute, we have also accepted a great responsibility for the future, for now the Federal Council must determine how the next satellite is to be financed. The Australis Oscar 3 satellite is well in hand and the Federal Executive has made a grant of \$300 of its funds to the group to enable the construction of a working prototype of the next satellite for presentation at the Convention.

One of the Amateur bands which would seem to be under considerable attack (at least in Australia) is the 432-450 MHz allocation. The utilisation of these frequencies for sophisticated amateur equipment and amateur beacons is one of the best justifications for the retention of these frequencies. In any event, in my view, the fostering of this sort of activity—which is in the interests of Amateur Radio as a whole, is one of the inescapable responsibilities of our organisation.

FED. REPEATER SECRETARIAT

During the year it became necessary to define with some precision the basis upon which the Federal Repeater Secretariat was appointed and in this connection the relationship between the Division from which it was appointed and the Federal Executive.

As a result of my discussions with the N.S.W. Division on 17th November, 1969, the following duties of the Secretariat were defined:

- (a) To inform and advise Federal Council, through the Federal Executive, on all matters pertinent to the use of Repeater/Translator stations in the Amateur Service.
- (b) To provide assistance for the Federal Executive in liaison with the F.M.G.'s Departmental Central Office on all matters referred to the committee.
- (c) To recommend the use of specific frequencies within the authorized bands for such services.
- (d) To formulate standards for the location, design and installation of such stations in order to assist the licensing authorities to license to the licensing authorities for permission to use these facilities.
- (e) To liaise with Divisional Repeater/Translator committees and advise on all matters related to the use of such Repeater/Translator stations.
- (f) To undertake such other tasks as are referred to it by Federal Council.

In addition, the following mechanics of the appointment of the Secretariat and the definition of the responsibilities were spell out.

Federal Executive shall call upon that Divisional committee members of the Secretariat, such members to be appointed by the Federal Executive annually. Federal Executive may re-constitute the Secretariat at any time at its discretion, or if requested to do so by the Divisional providing the members of the Secretariat. The Federal Executive will appoint a chairman of the Secretariate who may be appointed a co-opted member of the Executive in accordance with Clause 28 of the Federal Constitution.

Motions to this effect were passed by the Council of the N.S.W. Division and the Federal Executive Mr. Tim Mills was appointed a co-opted officer and chairman of the Federal Repeater Secretariate. Mr. Ian McKenzie remained a member of the Federal Repeater Secretariate. In October 1969 Mr. Chas Jones resigned so that he could become a member of the N.S.W. Division Repeater Committee and was replaced by Mr. John Rufus. VK2ZJQ. I would like to record the Executive's appreciation of Chas' enthusiasm and valuable work on the Federal Repeater Secretariate.

• V.H.F. PROGRESS

During the year progress has continued on the v.h.f. bands, and the following contests are notable achievements in this part of the spectrum:

On 1296 MHz. VK2EHD worked VK2AZAC over a distance of 148 miles, a band record. On 575 MHz. VK2EJL worked VK5QZ over a distance of almost 300 miles. On the 432 MHz. VK2ATN worked VK2EPP. On the 8 metre bands for the first time, the continent has been spanned each way with VK2ACT, VK3AMM and VK5ATN, and possibly others, working VK2EPP in Albany.

• INTRUDER WATCH

The Federal Intruder Watch Co-ordinator, Dr. David Wardlaw, has devoted a considerable effort this year, attempting to create an active Intruder Watch organization. As will be seen from his report, the response that has been received has been very poor indeed. This surprises me, as I would have thought that many active Amateurs would be prepared to assist in the activities which I imagine to be a very important aspect of our preservation of our frequencies. Nonetheless, the lack of response raises the question for Federal Council as to whether the continued effort in this regard is justified. There is no doubt to be little point in devoting a great deal of energy to an activity which is achieving very little.

• HOW TO BECOME A RADIO AMATEUR

At long last and after many delays, this is with the printers and we expect it to become available at the end of March. What a relief it will be to have it distributed by the Divisional. This is one task that I am sure Executive is glad to see the end of. I am also sure that this publication will fill a long standing need.

• FEDERAL EXECUTIVE

Between April 1969 and February 1970, the Federal Executive held 13 meetings. The attendance at those meetings was as follows:

M. Owen	13
P. Williams	13
J. Battwick	1 (Resigned after Fed. Convention)
G. Pithier	11
H. Rankin	10
D. Wardlaw	10
A. Seedman	4 (Resigned June 1969)
E. Connally	3 (Resigned Nov 1969)
W. Roper	4 (Appointed Nov 1969)
K. Pincock	7 (Appointed June 1969)

• WORKLOAD OF FEDERAL EXECUTIVE

During the past year, the Federal Executive has become increasingly concerned at the inordinate workload that is borne by a limited number of people, in particular, by the Editor of "Amateur Radio" and by the Federal Secretary. As each year goes by, the responsibility borne by these two officers increases, and even though the workload has been spread and the responsibilities shared as far as is practical, the workload imposed on the Federal Secretary is quite unreasonable. It is impossible to spread this workload indefinitely without losing continuity, and in fact devoting more time to the instruction and co-ordination between the various persons undertaking the task. In my view, the need for a full time paid manager is becoming increasingly absolutely essential for the continued operation of our Federal body at its present level of activity.

So far as the magazine is concerned, it is not in the long term interests of our Organisation that it should be dependent on a person such as our present Editor who is prepared to devote a major part of his leisure time to the management of the magazine. There is again here a performance of a task that must be performed by one person alone. This problem has reached critical proportions, as it is no longer fair nor reasonable to expect volunteers to make such great sacrifices of their time and energies. A paid manager must inevitably result in substantial subscription increases throughout Australia. The alternative is to simply abandon our Federal Organisation to the limbo of things to be done when time permits.

• CONCLUSION

In reviewing the activities of the past year, I am acutely conscious of all those many people to whom our thanks must be recorded because of their contributions. Dr. David Rankin has been able to devote less time to Institute activities than he would have wished. He has, however, carried out his responsibilities as Federal Activities Officer with his usual enthusiasm. In addition, as Federal Vice-President, I must thank him for his advice and assistance during my year. David's experience and common sense have been of great personal assistance to me.

I have already referred to the enormous workload undertaken by the Federal Secretary Peter Williams and I have been in almost constant communication with him. The year has also discovered that the work of the Federal Secretary that is seen by the Federal Council is only the tip of the iceberg. Peter has devoted endless hours to the Institute, and if you agree with me, in the year just past, he has deserved a substantial portion of the credit for that success must lie with him. Despite an ever increasing workload, Kevin Connally carried on as Federal Treasurer until near the end of May. Kevin's health has been failing, and Mr. Bill Roper, Kevin never wanted to be Federal Treasurer—yet he undertook the task and has kept our books in order during the past year. We are delighted to be joined by Bill Roper, who brings with him both enthusiasm and experience.

I have already acknowledged the work of David Seedman as Intruder Watch Co-ordinator. David, through his experience, particularly in the United Kingdom, is a valuable member of the Executive, when discussing matters of an international nature, and I have valued his advice throughout the year.

During the year, Alf Seedman resigned, and was replaced by Ken Pincock, the Editor of "Amateur Radio". On behalf of Executive and the Federal Council, I would like to extend our thanks to Alf for the work that he did for the Federal Executive during the years he served on it.

No more experienced or active member could be found than Ken Pincock and his presence on Federal Executive has brought the Executive's relationship with the Institute's publications much closer.

Geo Pithier has undertaken a variety tasks during the year and to him I extend my personal thanks for his unfailing support.

In acknowledging the assistance of the various people who have contributed to our Organisation during the past year, there is one person that I cannot overlook, namely, the former Federal President, Mr. Bill Roper. Bill has personally much appreciated his guidance and advice during the year, and I have felt that I have always been able to call on him for assistance where necessary. In addition, the compilation of the Minutes of the 1969 Federal Council meeting in March, a monumental task, was shared between Max and the Federal Secretary, Peter Williams.

When all seemed lost, so far as writing a history of the Institute for publication in "Amateur Radio" during 1970 was concerned, Max stepped in and took on the task and I am grateful to him. On reading the results of his research, I suspect that he did not realise the enormity of the task. To Max I express the thanks of the Federal Executive, and also my personal thanks.

Finally, again on a personal note, I would also like to record my appreciation to each member of the Federal Council for his support during the year. As I stated at the outset of this report, I believe the year past has been a successful one, and I am grateful to all who have supported the Executive. I believe that we may look forward to the future with some confidence, for I am sure that our Organisation will continue to grow and prosper, so long as it has the support of our members generally. This support is dependent upon the members knowing and accepting what is required of them. This is in turn dependent on all our members being constantly informed on those matters that are of a Federal concern. One great difficulty of the Federal Executive is that in that many members of the Institute's expenditure of considerable time and effort are not capable of, or suitable for, reporting in detail. The continued support of the Federal Council, and through them, the Divisional Councils is essential.

Because, at a national level, our organisation is a Federation, and therefore necessarily complex, the risk of remoteness is very real. We cannot afford to be remote—we need the support of every Amateur in Australia.

I believe we can justify that support.

Michael J. Owen,
Federal President, W.I.A.

• HELP WANTED

The Publications Committee is in urgent need of extra manpower. Our present Secretary (Bill Roper) has joined Federal Executive as Treasurer, and wishes to relinquish his position with this Committee. This job entails two or three evenings per month, depending on how much work results from our monthly meetings. Although not necessary, it would be convenient if a replacement could be found who resides in one of the eastern suburbs of Melbourne.

We are also seeking somebody to assist with magazine and book reviews. Syd Clark does the job now and it is becoming a bit too much for one man to read them all and do the review. Syd would prefer that his assistant live in the Hidelberg-Rosanna area.

Amongst the overseas magazines we receive are the journals of our kindred Societies in Italy, Spain, Belgium, France, Germany, Holland, Norway, Sweden and South Africa. We will be happy to make these available to anybody who can read these languages if in return they will do a brief review of the contents for us.

Interested persons are asked to contact the Administrative Secretary of the Victorian Division, W.I.A., 478 Victoria Parade, East Melbourne, or phone 41-3553 and indicate in what way they can assist us. Mrs. Bellairs will pass the details on to the committee member concerned, who will in turn contact you.

DX

Sub-Editor DON GRANTLEY
P.O. Box 222, Penrith, N.S.W. 2350
[All times in GMT]

Again we have had a very profitable month, due to rather poor conditions, and a couple of more than interesting expeditions. T1C1 from Cocon is was the first to appear, and despite evident problems with the rain, it would seem that they had a successful trip. They were due to come on the air from Seravans Bank on the return journey, but from comments by some of the DK gang, they had not appeared by Feb. 28. QSLs for the operation go to T1C1CM with SAE plus ITC-A.

The second operation of interest this month was the trip to Marion. Between Feb. 11 to Feb. 27 I did not hear them, however from comments on the air it would seem that the operation was a success. The QSL information is shown in Geoff Watts DX News Report, and QSOs via QTH. They were on 160 in their case, a SASE is all that is needed for the W Bureau will not be used, however for the rest of the world, the QSLs are to go direct to MP4BNH, Box 188, Manama, Bahrain. Is. with SAE and the usual ITC. This has been a costly trip I believe, and the SAE will keep costs down.

FOC8Y has been QRV from Nukuhiva, Marquesas since Jan. 18. Jean is the operator and he has been reported here quite frequently. I assume the country is French Polynesia, however the actual locale is around 160 deg. west and near enough to S of south of the equator. FOARIA will make a visit there later this year.

GM3KJ and GM3QGQ/A operation on Feb. 6 was from Kinross and is of particular interest through being the most difficult of the Counties to work.

Egypt is not in the Amateur Radio news very often these days, but there is regular activity from that country, the last of interest being "Moby" SU1MVA, who is now on 885 usually around 14300 and has been noted in this country at around 1700z. QTH is Box 39, Cairo.

For the Island hunters, there is regular activity from the Mariana's by KG6MM whose manager is W5CTN and KG6SY whose cards go direct to him at Box 861, Capital Hill, Saipan, Mariana's.

One or two this month from shapes who have heard the RA prefixes on 10 m. RAJAZY PCBK and SJCC are three mentioned by Geoff Watts as active, and they are all Russian VHF stations, operating on 10 metres and up. Likewise the UK prefixes are also Russians.

From the VP area there has been quite a host of stations. VP6PMY is QRV from Merseret until March 1, QSL to his home address Box 100, Merseret, Ethiopia. Lunda, QSL to G1GPO, VP6KIN "Ken" from St. Kitts, QSL to VE3EUV. VP5GM on Cairos until April then home as GJ6WOW where his QSLs should be sent. VP5TH "Tom" also on Cairos says QSL to VE3EUV. VP5V is QRV from 1000z to 1100z. It is on 80 metres quite regularly at around 0400z, which is of little use to us here, but he is on other frequencies as well, and his manager VE1AJB provides a rapid QSL return.

YU1TU and YU0UZU were in operation from Jan. 1 to Feb. 11 from C.C.R.L. Conference in New Delhi, A.Q. QSL to YU1TU, International Amateur Radio Club, I.T.U., Geneva 20.

The activity around the New Zealand area still continues. Barry ZM1BNA due to return home at the time of writing and the country he is going to has not been named, but it is over the required 3400 miles from the point of administration. ZM3PQO/C still active, and his manager ZL1ZAFZ has a new batch of cards for him. On the Kermadec's Roy ZK1AA/K still continues, and he is now heard daily on S1 50. Several VK1/ZL stations have been heard but to date none have been worked. His listening time on this band is 0600z.

ZK1MN has been active from Manihiki since Jan. 1, and is still active, but expects to have SSB gear operative on all bands by April.

Harold AX0LD gets on the air when the opportunity arises, but expects to uplift his activity soon. His manager ZM1ZAFZ has a skee with him 2200z Sunday on 14180, and they will be pleased to stand by for anybody needing Macquarie.

ZD8BN on Gough Is. has the following skee, with ZD8BN/C joining in on occasions from Tristan da Cunha. On Monday, Tuesday and Friday, 1900 to 1900, and 1900 to 1900. Tues-

day, Thursday and Saturday, 1600 to 1100, 1805 to 1800, and 2300 to 0100z. His frequencies are 2.5, 7.1, 14220 to 16150, and 14250 to 1710. He is looking for contacts in this part of the world.

Another looking for ZL contacts in particular is Arctic 8000, who is active on 10 metre bands and QSOs via QTH. Box 80, Mbabane, Swaziland. Other activity from there is by ZD8BN, mainly on 10 metre CW. ZD8BN mostly 30 SSB, ZD8BN is on CW only but on all bands, while ZD8T and ZD8DV are active on very rare occasions.

Z323MI is well under way with his SSB operation from Marion Island and was causing the big pile-ups for some days. He expects to be on 15 with this mode shortly. QSL to ZW5W. QSOs via QTH. Box 340 to 250 KHz. up after each QSO, and listens 240 to 250.

The call ZD8BP was issued to Andy HPPZ/C/MM who visited Tristan da Cunha late in Jan. whilst the research vessel Vema was in Tristan waters. QSL to VE1AJB.

SH3KJ A and SH3LVA A were due to resume operation on 15 and 20 m. to Mar. 2. The location of this one is S 55 south 36 east. operation mainly on 15 and 20 metres QSLs for the former to WIVTR, the late to VE3ODX.

K4CUSA from Palmer Arch says QSL to K4BPP, K4CFA on from 15, QSL to K4CFA, K4CFA on 160. Tap to 1000z. QSL to K4CFA and K4MHD from American Samoa often on 2607 CW at about 1200z, says QSL him to the Dept. of Education. Page Page.

We are aware now from our contacts on previous occasions, however the actual locale is around 160 deg. west and near enough to S of south of the equator. FOARIA will make a visit there later this year.

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AWARDS

Home Country Award—For working home stations in 1970 VY stations, in fact all countries other than Europe, need 3 points, each QSO counting as one point except for those made on Sept. 30, which count as three points. GCR, 100 plus 4 I.R.C.s to A.R.I. Box 361, Honolulu, Hawaii, by Mar. 31, 1971. Available to S.W. 8's also.

ZM Award—There has been quite a lot of enquiries coming to me as to whether this award is available to S.W. 8's. In actual fact it is and S.W. 8's George of VK4 was amongst the earliest recipients.

Mayflower Award—To commemorate the 350th anniversary of the sailing from Plymouth at the Pilgrim Fathers for America. All profits from this will go to the Fund for providing Amateur Radio equipment for the Overseas Homes. Overseas stations need to work five stations in the city of Plymouth, all QSLs from Jan. 1 this year. Also available to S.W. 8's, QSLs for 1/2 sterling, payable monthly to C.H.A.R.M. Fund, and with application and check to G3VUC, Filton Park, Horverbridge, Liverpool, Devon, PL8 1TE, England.

South American Award—This award requires QSLs from, C.R., C.X., C.Y., H.C., H.L., L.A., Q.P., P.R., V.P., Z.P., etc. The application together with QSLs plus one dollar U.S. to H.C.I.H.T., Box 583, Quito, Ecuador.

The Class W Award is issued by the S.W. 8's Club Activity of Iderberg, Sweden, for working stations in the city of Iderberg, Sweden. The requirements as far as we are concerned are Class A 15 stations, Class B 10 stations, Class C 8 stations, and Class D 5 stations, have to be worked between Aug. 15, 1970 and Nov. 30, 1970. The mode Fee is one dollar or 15 I.R.C.s for the basic award, scale for higher classes need two more I.R.C.s. Applications to Awards Manager, Box 209, S-780 24 Iderberg, Sweden. To SWLs.

Manitoba Centenary Award—Five points per VE4 station per band per mode using 1876 QSOs only, 100 points needed, cost is two I.R.C.s and the manager is VE1AJK.

Art's Award—This is quite a simple one, which you can obtain from Boys' Life Radio Club Awards C/o Scientific Dept. of Boy Scouts of America, New Brunswick, N.J. 08805, U.S.A. All you need is one card from Art, and a call up to zero, no charge and is available to SWLs.

On the subject of Awards, quite often ones come along which we don't happen to hear about, so if you happen to come across any of particular interest, I would be pleased to have the details, also their availability to SWLs.

CONGRATULATIONS

Whilst this item has no direct bearing on the purpose of this page, that is to provide DX information, it will be of interest to many Amateurs and SWLs. Many of us started the hobby in interest in Radio through reading certain articles written by Art Cushing in the earlier days of the magazine "Electronics Australia". Art is totally sightless, but despite his handicap, he has worked hard to assist others in the radio field, and spent much time doing welfare work for the blind. For his services to radio, broadcasting, journalism and blind welfare, Art was awarded the M.B.E. in the New Year's Honour list, and I would like to add a word of congratulation to him on behalf of the many W.A. members who got a start in the hobby through his efforts.

On the subject of the aforementioned magazine, recently I had cause to reply to one of their queries from a newcomer to the radio hobby. He asked for a list of identifications for SWLs. My reply received a full list, and in one of their feature columns, and shortly after its release I was inundated with letters from young and not so young chaps who wanted to know more about the various aspects of Amateur Radio. These chaps were from a group outside the reach of the Y.R.A. and Radio Clubs, and I have done my best to assist them, however there is apparently a vast number of interested persons who could be recruited, with the following as lead at once, but I would like to hear from any club officials anywhere who are prepared to assist any enquiries in whom I may direct them. Judging by the lack of activity on the DX bands, and the lack of the prefix, we should follow up on the trail of any chance we have to add to our numbers.

MORE QTHs

ZJ1AL—Fred Powell, A.L.D. Mission, U.S. Embassy, Tunis, Tunisia.

SA1TK—Box 2008, Tripoli, Libya.

SA4TC—Box 6237, Tripoli, Libya.

SH2ES—Amateur Radio Club, The English School, Nicosia, Cyprus.

SL5F—C/o Radio Station ELWA, Monrovia, Liberia.

(Continued on Page 34)

Overseas Magazine Review

Compiled by Syd Clark, VK3ASC

"HAM RADIO"

November 1968—

What's this we hear about Op. Amps. by WB2EZZ? The title just about describes the author's intentions. Describes Operational Amplifiers, what they do and how they are used. 17 pictures, 12 circuit diagrams.

Fixed Tuned Receiver for WVVY, WGGXN. A relatively simple transistor/IC circuit for reception of WVVY on your favourite frequency —15 MHz.

A Multiband Long-Wire Antenna, W2FQJ. Some 300 feet all told. No traps, some jumpers.

One More Electronic Keyer, VE7BPK. ICs and other solid state components in a solid construction keyer.

Antennas and Capture Area, K6EMIO. Some theory you may not have seen elsewhere.

Increased Sideband Suppression for the HT25, W3CM. None of 'em are perfect if you own one this could be for you.

Low Cost Amateur Microwave Antenna, K6HJL. Gain is stated to be 24 dB. at 3335 MHz.

A Tone Modulated Signal Generator for Two and Six Meters, WAOQIK. Crystal locked, too. Solid state two transistor.

Big Beam for Six Meters, W4ERO. Colinear. Repair Beach. Tuning Up 588 Transmitters.

The good oil.

October 1968—

Hot Carrier Diode Converter for Two Meters, K6CJU. Something new and complete instructions, too.

Practical Discussion on Product Detector Operation, VEGFN. One for all the side-banders.

Hot Carrier Diode Noise Blanker, W4KRE. His baby seems to be finding his way into more and more equipment. HF even have light emitting diodes at \$5 or \$6 plus tax.

Low Cost Integrated Circuit for Amateur ICs, WATKRE. Simple new consumer ICs shown, useful to the home builder who is looking for superior performance with less complexity.

Improving the F.M. Repeater Transmitter for Amateur Use, W6GDO. These simple modifications increase circuit Q and provide improved performance through lower receiver de-selectation.

Construction of High Frequency Diversity Antennas, W2WLA. Complete details on building high directivity directional antennas for 10-12 MHz.

Solid State Exciter for 432 MHz., W1OOF. Here's a solid state exciter that converts 20 mW. of two metre exciter to 32 watts on 432 MHz.

Calculated Received Power in a Radio Communications Link, WIEZT. A detailed analysis of just what happens to the hard-earned watts from your transmitter.

An Easy Two-Way DX Session for VHF, KV4FU/K5EDDX. Simple method of ensuring that you will be there during band openings.

High Linearity Voltage Controlled Crystal Oscillator, W6TOM.

"HAM TIPS"

This month I have for review a number of issues of R.C.A. Ham Tips kindly supplied by A.W.A. Ltd.

Vol. 25, No. 2: RF "Sample Box" for Space Monitoring of Amateur Transmitter Output, by W2GQK.

Vol. 25, No. 4: A Solid State AM Transmitter for 10-12 MHz. Operation, by W2GQK.

Vol. 27, No. 2: A VFO Calibrator, W2YWM.

Vol. 27 No. 3: Using the MOSFET as a Product Detector and AGC Gate, W3KDT.

Vol. 28 No. 1: R.C.A. Silicon Power Plastic Transistors in a Regulated DC-to-DC Converter, W6ZECZ.

Vol. 28 No. 2: An Audio Control System for SSB, W5YMN.

"RADIO COMMUNICATION"

December 1968—

The Integrated Circuit Approach to AGC, G4PDM. A very interesting idea. Good for those with access to a transistor farm.

The GRAY Two Watt Two Meter Transistor Transmitter, G8ARV, G8SD/E/T Diagrams and pictures.

Technical Topics, G3VA. G3PDM's high stability FET Vactar oscillator, continuously variable bandpass filter, monitoring drive voltages, active load, and much more. (Will you rang me at the office please call again.)

Antennas and Planning Permission, G1JAG. Could help some VKs.

A Bistable for Relay Control, G4XJP.

Band Pass Filters, G4JGP.

Rectifiers on a Bridge, G8ON. The SWR bridge is not an "island".

Changing to Metric in the U.K., E. Chickin, M.I.R.E. The differences between the Metric and Imperial systems are discussed and the Metric system is shown to have numerous advantages. This will be the first time Australian Amateurs also because Australia is also committed to "metrication" in the long term. With the change to Metric measure will come many alterations in dimensions of various products and for instance the familiar 1/4 inch tuning shaft, which is about 6.35 mm., will become 8 mm., which some 0.010 mm. smaller.

"RADIO 28"

November 1968—

Portable Extending Radio Mast, Z56ET. Five sections of square section tubing 18 s.w.g. 10.044 inch which telescope one into the other. The last section is 10.044 inch. The whole extends up about 16 ft. tall with two sets of guy or similar guys. 17 s.w.g. tubing will telescope if bought in 1/8 inch rises.

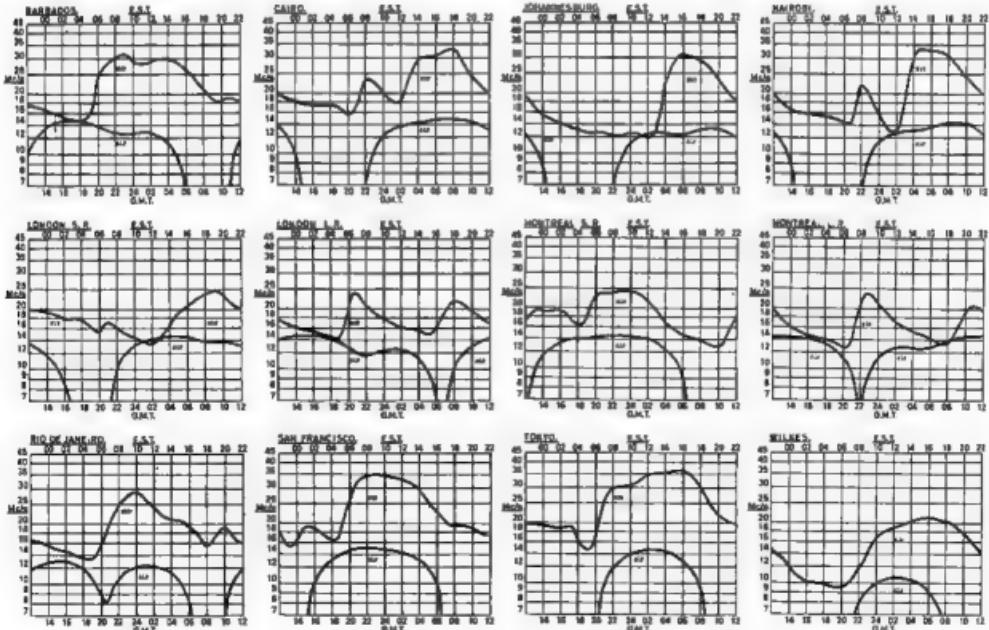
100 Metre DF Receiver, Z58PD. To hunt that 100 metre hidden tx.

Two Valve Complete SSB Transmitter, Z58DX. 2AU7 and 6BV8 in a phasing rig for one band.

A Method of Evaluating Slide Rule Answers, Z51MM. For the mathematically inclined.

(Prediction Charts by courtesy of Ionospheric Prediction Service)

PREDICTION CHARTS FOR APRIL 1970



Correspondence

Any opinion expressed under this heading is the individual opinion of the writer and does not necessarily coincide with that of the Publishers.

INTERFERENCE FROM RADAR-TYPE PULSES

Editor "A.R." Dear Sir.

For some time past radar-type pulses have been heard intermittently but loudly across the hf spectrum. At times the pulses exceed 50 dB and on the 15 and 20 metre bands are often heard simultaneously in Australia and Europe. The format is a regular series of short train of sharp pulses apparently of high power, repeated at short intervals and followed by clearly recognisable echoes.

On occasions the resultant composite interference is so persistent and strong that even s.s.b. voice communication is interrupted. Narrow band communications are not so seriously affected.

On the night of 10th February when this note was written, a persistent I tape recorded 15-minute sample showing how the pulses affected Amateur operation on the 15 metre band. This has been passed to the District Radio Inspector together with a formal request that something be done to minimize this type of emission.

The interference apparently originates in the United States and is said to be part of an exotic (American) ionospheric prediction system, which although attracting unfavourable comment from several sources, seems destined to continue unless the level of protest rises considerably.

Would members who are concerned about the selfish type of use of the hf spectrum in America please make an appropriate protest with either their local R.I. their W.I.A. Councillor and/or the A.R.S.I.

—Col. Harvey, VK1AU.

(Better still, refer it to your Intruder Watch Co-ordinator.—Ed.)

AUSTRALIA—AND CAPTAIN COOK

Editor "A.R." Dear Sir.

I refer to VK1IJG's opinion expressed on page 29 of "A.R." Mar. 1970, in which he makes an "evil" "boob" in my opinion, by saying that he hears "nonsense on the air" in relation to the Australian call signs, and then offers his version of what the so-called "nonsense" should become.

I refer Mr. George to the Radio Regulations, Geneva 1968, page 224, Regulation 772.21(i), which, in relation to call signs, reads as follows:

"Amateur and experimental stations—one or two letters and a single digit (other than 0 or 1) followed by a group of not more than three letters"

END
"73 2 However, the prohibition of the use of the digits 0 and 1 does not apply to amateur stations."

To the writer and, I hope, to all average, clear thinking readers, the aforesaid regulations clearly set out the Amateur Radio call sign position.

Incidentally as VK1IJG is concerned, I feel it's "use" of the body being the "other foot with" "nonsense on the air" being applicable to Mr. George if he introduces the word "Australia" into preceding his call sign.

—Eric Trebilcock, AX-13042.

SIT AND THINK

Editor "A.R." Dear Sir.
I wish to offer my sincere congratulations to those responsible in the Wireless Institute of Australia for the inauguration of the Cook B-Centenary Award. In line with other segments of our Australian community, we cer-

CHANGE OF ADDRESS

W.I.A. members are requested to promptly notify any change of address to their Divisional Secretary—not direct to "Amateur Radio".

tainly have something to celebrate and I think the majority of Amateurs will support the W.I.A. in a magnificent effort to create greater interest in our hobby, communication with Radio Amateurs throughout the world.

Monitoring the 20 metre band since the beginning of January this year, I have noticed a welcome increase in c.w. and s.s.b. activity and from comments on the air it would appear that the AX Award has contributed to a large degree to this activity.

However, as the English mathematician, Sir Isaac Newton, stated in 1700, "To every action there is an equal and opposite reaction", I now refer to an international incident monitored recently on the 20 metre band.

Scene 1: American Amateur. "Say OM, you have the VK prefix, how about the AX prefix to give me another contact?"

Australian Amateur. "Sorry OM, I don't alter my call sign for anybody."

Scene 2: American Amateur in a long QSO with a VK3 over the long path. American asks for an AX prefix. Australian Amateur disappears.

Scene 3: A VK2 character, well known for his sales ability, stated on the 40 metre band: "People come to me not to discover the East coast of Australia and I will not use the AX prefix."

Scene 4: I give a list of the VK3 characters who work a daily net on 7.1 MHz, particularly at 8 a.m. after they have had a bad night and try to get an AX prefix out of them.

I conclude by suggesting that there are a number in our ranks who should sit and think, and having sat in contemplation, thank the good Lord that they are part of a young country built on a heritage of courage and endeavour.

I await their reply.

—Wal E. Salmon, VK1ESA.

RADIO TELETYPE INTERFERENCE

Editor "A.R." Dear Sir.

From conversation with other Amateurs it appears to me that a lot of r.t.t.y. Amateur-band interference is blamed on Amateurs. Those who are interested in this phenomenon on the Amateur bands should note that, in my experience anyhow, Amateur r.t.t.y. operators transmit just outside the phone bands in the c.w. section only cover a narrow section of the band.

It is a very simple matter to determine if the r.t.t.y. operator is an Amateur as QSOs are of the same form as phone QSOs, of comparatively short duration, and also the Amateur finishes each over with his call sign in c.w.

So be happy in the knowledge that the r.t.t.y. QRM spoiling the bands, 30 metres especially, is not caused by your fellow Amateur.

—Peter H. Brown, VK4PJ.

OBITUARY

VINCENT JEFFS, VK4VJ

The VK4 Division recently suffered a severe loss in the passing, aged 88 years, of Vince Jeffs, VK4VJ, an extremely popular member of the Division. He was comparatively recently elected a Life Member for his services to the Division.

Vince, who passed away while in hospital, had some two years ago retired from business because of ill health and, while he had been on the occasion had the misfortune to lose his wife.

To his wife and married daughter, VK4 members extend their sympathy.

Vince, licensed in 1921, was one of the earliest experimenters on s.s.b. and in the use of transistors. He willingly passed on his knowledge.

His interest in field days, Scouting, c.w. contests etc. was unending, by his full participation while he operated VK4VJ for a time and as a capable telegraphist he handled Morse sessions.

Vince, well spoken and with a fine sense of humour, will be missed for many days.

CONTEST CALENDAR

Until 18th April, I.A.R.C. Propagation Research Contest (Phone)

11th/12th April: "CQ" W.W. WPX S.s.b. Contest

18th/19th August: Remembrance Day Contest

3rd/4th October: VK/ZL/Oceania DX Contest, Phone Section

10th/11th October: VK/ZL/Oceania DX Contest, C.w. Section

10th/11th October: R.S.G.B. 22 MHz. Phone Contest

24th/25th October: R.S.G.B. 7 MHz. DX Contest (Phone)

5th Dec., 1970, to 11th Jan. 1971: Ross A. Hull V.h.f. Memorial Contest.



WIRELESS INSTITUTE OF AUSTRALIA FEDERAL EXECUTIVE

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★ "OST"—Associate membership and renewals, \$6.40.

★ R.S.G.B. "Radio Communication" (ex "The Bulletin") is only sent with membership of Society. \$5.50. Send for application form.

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★ "73" Magazine, \$5.50; Three Years, \$11.50.

★ "Ham" Magazine, \$5.50; Three Years, \$11.50.

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Receipt of your first issue will serve as acknowledgment of your sub. Allow six weeks for delivery.

FEDERAL AWARDS

COOK BI-CENTENARY AWARD

The following additional stations have qualified for the Award

Certi No.	Call	Certi No.	Call
41	KG1AL	73	AXA4Z
42	AX2A	74	2ZBAAA
43	AX2RO	75	2ZMTC
44	AX3HL	76	WS5KZ
45	AX7KW	77	ZM1QW
46	AX2ZE	78	VQRCW
47	UB5WE	79	AXAHA
48	2ZBES	80	AX7V
49	AX5WT	81	OBHBD
50	AX2ES	82	WS6AM
51	KASMF	83	KPC1L
52	UPL5W	84	2ZD7V
53	MRWWSG	85	KG4AS
54	CP1GN	86	HRK1AS
55	LA8J	87	AXHEF
56	ZM1GJ	88	KR1EJ
57	ZS5H	89	GUJXN
58	2ZBAMN	90	2ZB7J
59	AX2EJ	91	AXRER
60	AX7RJ	92	WERU
61	AX4VX	93	W1AA
62	WEAO	94	KOKGU
63	AX2DK	95	D1NEM
64	AX2XT	96	HS1ABA
65	AX4WY	97	WASSMM
66	AX2KA	98	AX5GA
67	ZM1NH	99	AX1CK
68	AX2DQ	100	ZL4VX
69	KP1AST	101	ZL4NH
70	GPVPI	102	AX2EF
71	AX2PF	103	DJ5DA
72	JH1KXV		

VK3 S.W.L. GROUP

REGISTERED S.W.L. NUMBERS

Due to the fact that the Short Wave Listener Group have been without a Secretary for some time, records have got into arrears. We are happy to announce that the position has now been filled and we want to rectify any anomalies that could exist.

Would all members who have applied for an S.W.L. number and have not as yet received it, please communicate direct with the Secretary, who will then answer by return mail.

Please contact:

Mr. E. Milton,
21 King William Street,
Reservoir, Vic. 3078; or Phone 47-1378.

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CAPTAIN COOK BI-CENTENARY CELEBRATIONS, 1970

Expedition to Cape Hicks

During April 1970 representatives of the Victorian Division of the Wireless Institute of Australia will be operating an Amateur Radio Station at Cape Hicks, the first point of the Australian coastline sighted by Captain Cook in 1770. The Amateur Radio Station, using the call sign AX3AWI/Portable, will contact Australian and overseas Amateur Stations during the three-day period of operation.

DETAILS

Date: 18th, 19th and 20th April, 1970.

Call Sign: AX3AWI/Portable.

Location: Cape Hicks, Victoria, Australia.

Bands: 15, 20, 40, 80 and 160 metres, also v.h.f.

Times: 0200 GMT 18/4/70 to 0200 GMT 20/4/70.

QSL and Awards—A special certificate and QSL card will be issued—applications via VK QSL Bureau, or direct to address below.

Further information can be obtained by contacting Russell Kelly, AX3AG, Divisional Secretary, W.I.A. Vic. Div., P.O. Box 36, East Melbourne, Vic., 3002.

W.I.A. D.X.C.C.

Listed below are the highest twelve members in each section. Position in the list is determined by the total number of countries worked. The first number represents the participant's total countries less any credits given for deleted countries. The second number shown represents the total D.X.C.C. credits given, including deleted countries. Where totals are the same, headings will be alphabetical by call sign.

Credits for new members and those whose totals have been amended are also shown.

MEMBERS

Cert. No.	Call	Total	
105	VK5AB	297/314	
106	VK5A2Z	103/105	
107	VK5KEF	99/100	
VK5E2	241/264	VK5TGT	164/165
VK5A2MK	211/211	VK4RP	160/160
VK5BB	190/193		

MEMBERS

Cert. No.	Call	Total	
301/315	VK5UW	272/288	
VK5Q1L	VK5ZD	230/231	
286/315	VK5ARX	269/278	
VK5E9R	287/269	VK5RU	266/288
382/285	VK5NC	263/285	
VK5A2PK	276/263	VK5TY	259/271

MEMBERS

Cert. No.	Call	Total	
214/230	VK5MK	304/324	
VK5A1R	312/230	VK5EO	302/320
VK5ZCH	313/232	VK4PJ	297/322
VK5TVM	308/230	VK5NC	284/305
VK5E2A	297/251	VK5ARX	281/301
VK5TY	301/281	VK5TGT	280/309

MEMBERS

Cert. No.	Call	Total
123	VK5KEF	101/100

SILENT KEYS

It is with deep regret that we record the passing of—

VK3KX—Ronald Tandy

L-3324—Jeff Van Loon

VK4VJ—Vincent Jeffs

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FOR SALE FP50 Receiver, six Ham bands only plus WWV. Excellent order with 12v. transmitter supply \$150 o.n.o. One Palms. Testor. Tuner built in. Multimeter 315. One SWR Meter, 75 ohms, \$15. S2 Set poor working condition and appearance, with extra kit of valves \$25 o.n.o. Call Sunday or write. VK3ZVZ, Q Falls, S. Melton St., Glenroy, Vic., 3046.

FOR SALE Galaxy 3 S.B. Transceiver, complete with matching power supply and spares, crystal calibrator and vox \$325. Phone 560-3845 (Melb.).

FOR SALE Galaxy 3 Transceiver, perfect condition, with m.c. vox, s.t.u., power supply, handbook, \$240. Phone Melb. 82-7308. VK3ZZL, 4/34 Auburn Gr. Hawthorn, Vic., 3009.

FOR SALE General Coverage Communications Rx ARI, front end, double conversion, 14 valves. BFO, pentodes, m.c. vox, m.c. oscillator. Intermod. Photocathode available. \$10. 80 Boundary Rd., W.L. Lambeth, 38 Boundary St., Hawthorn, Vic., 3006. Phone 397-8773 (Melb.).

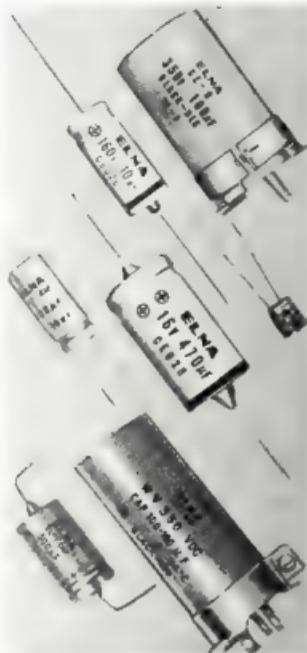
FOR SALE Hallicrafters SX101, Mk. 2, Ham-band Rx, 160-10 metres. Switched SSB, xtal cal. C. 0.5 KHz., c.w. set. Excellent performer. VK4FD, 28 Steiglitz, 38 Monash St., Burwood Old, 4070.

FOR SALE VK4PCP Transistorised Amateur Band Receiver. 12v. d.c., "E" 12v. 3.5 Kc. converter (no xtal), professionally built. Had little use. \$85. M. Hart, Rosewood Junction, Vic., 3128.

FOR SALE Yassu Musen 100W 1400B Receiver and P1100B Transmitter. In mint condition. Switch on puts them in transceive and has extras such as WWV, xtal calibrator, FM detector, CW filter and extra xtal. Gift at \$450. VK5AS, 39 Tapleys Hill Road, North Geelong, Vic., 3220.

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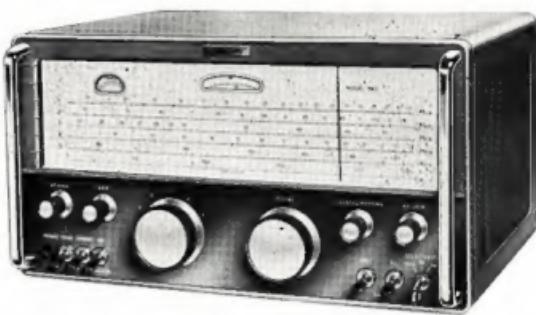
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Measuring Ranges:

DC Volts: 0 to 1.5, 5, 15, 50, 150 and 1,500V.
AC Volts: 0 to 1.5, 5, 15, 50, 150, 500, 1,500V. r.m.s.
0 to 14, 42, 140, 420, 1,400 and 4,200V. p.p.
0 to 1.5, 5, 15 and 30V. r.m.s. in R.F.
Resistance: At Centre Scale—
10, 100, 1K, 10K, 100K, 1M and 10M Ohms.
Power Level: —20 to 250 D.B.M. in two ranges.

Accuracy:

DC Volts: Better than $\pm 3\%$ of rated value.
AC Volts: " " $\pm 3\%$ " "
Resistance: " " $\pm 3\%$ of centre scale value.
D.B.M.: " " $\pm 4\%$ d.b.m. at 0 d.b.m.

Input Impedance:

DC Volt Ranges: 11 megohms + 3 pF. in parallel.
AC Volt Ranges: 5 megohms + 70 pF. in parallel.^a
or 5 megohms + 25 pF. in parallel.^a
or 1 megohm + 4 pF. in parallel.^b
^a On R.M.S. and P.P. Range and used with Multiprobe.
^b On R.M.S. and P.P. Range and direct coupling.
^c On R.F. Range and used with Multiprobe.

Frequency Response:

R.M.S. 20 Hz. to 5 MHz. within ± 1 db.
P.P. 20 Hz. to 5 MHz. within ± 1 db.
R.F. 5 KHz. to 200 MHz. within ± 1 db.

Dimensions and Weight:

10 1/4" x 5 7/8" x 4 5/16"
5.5 lbs. approx.



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